DOCUMENT RESUME

ED 210 557 CE 030 874

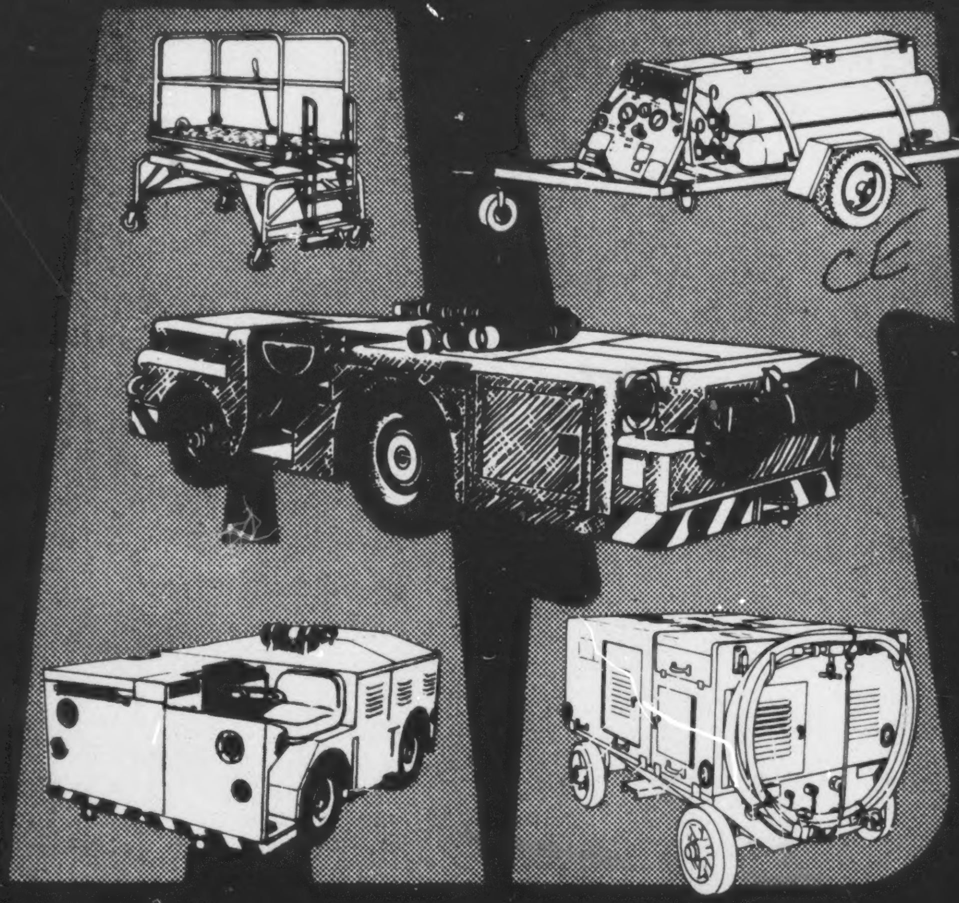
AUTHOR	Grant, Jesse R.; And Others
TITLE	Aviation Support Equipment Technician (ASE 3 & 2 and ASM 3 & 2). Volume 1, Basics. Rate Training Manual and Nonresident Career Course.
INSTITUTION	Naval Education and Training Program Development Center, Pensacola, Fla.
REPORT NO	NAVEDTRA-10325
PUB DATE	81
NOTE	378p.: Photographs will not reproduce well.
EDRS PRICE	MF01/PC16 Plus Postage.
DESCRIPTORS	*Aviation Mechanics; Aviation Technology; Aviation Vocabulary; Behavioral Objectives; Engines; Equipment; *Equipment Maintenance; Fuels; Hand Tools; Independent Study; *Learning Activities; Learning Modules; Machine Tools; Maintenance; Mechanical Equipment; Mechanics (Process); *Military Training; Postsecondary Education; *Programed Instructional Materials; Staff Development; Technical Occupations; Vocational Education
IDENTIFIERS	*Navy

ABSTRACT

This Rate Training Manual and Nonresident Career Course (RTM/NRCC) form a self-study package that will enable aviation support equipment personnel to help themselves fulfill the requirements for advancement. Designed for individual study and not formal classroom instruction, the RTM provides subject matter that relates directly to the occupational standards of the Aviation Support (AS) Equipment Technician. The NRCC provides a way of satisfying the requirements for completing the RTM. Assignments in the NRCC include learning objectives and supporting items designed to lead the student through the RTM. Volume 1 is the basic manual for the AS rating. It provides the beginner with fundamental ground support equipment shop organization and shop procedures. It includes the rate structure, with a short history of the AS rate, supply publications, Naval Aviation Maintenance Program, and ground support equipment, tools, test equipment, materials, and hardware also are discussed; and the appendix contains a list of acronyms and definitions of terms used in the course. (The Aviation Support Equipment Series, of which this document is the first volume, replaces chapters of the three service ratings, Aviation Support Equipment Technician's E (Electrical), M (Mechanical), and H (Hydraulic). (KC)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED210557



CE

AVIATION SUPPORT EQUIPMENT TECHNICIAN (ASE 3 & 2 AND ASM 3 & 2)

VOL 1, BASICS

NAVAL EDUCATION AND TRAINING COMMAND

RATE TRAINING MANUAL AND NONRESIDENT CAREER COURSE

NAVEDTRA 10325

CE 030 874

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

- Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

Although the words "he", "him", and "his", are used sparingly in this manual to enhance communication, they are not intended to be gender driven nor to affront or discriminate against anyone reading *Aviation Support Equipment Technician (ASE 3 & 2 and ASM 3 & 2) Volume 1, Basics,* NAVEDTRA 10325.

Naval Education And Training Program Development Center

AVIATION SUPPORT EQUIPMENT TECHNICIAN (ASE 3&2 AND ASM 3&2) VOLUME 1, BASICS

NAVEDTRA 10325

DEPARTMENT OF THE NAVY
CHIEF OF NAVAL EDUC AND TNG

1981 Edition Prepared By
ASCM Jesse R. Grant, ASC Stanley G. Tharpe,
and ASC Thomas Whiteman (Ret.)

PREFACE

The ultimate purpose of training Naval personnel is to produce a combatant Navy which can insure victory at sea. A consequence of the quality of training given them is their superior state of readiness. Its result is a victorious Navy.

This Rate Training Manual and Nonresident Career Course (RTM/NRCC) form a self-study package that will enable Aviation Support Equipment personnel to help themselves fulfill the requirements for advancement.

Designed for individual study and not formal classroom instruction, the RTM provides subject matter that relates directly to the occupational standards of the Aviation Support Equipment Technician. The NRCC provides a way of satisfying the requirements for completing the RTM. Assignments in the NRCC include learning objectives and supporting items designed to lead the student through the RTM.

The *Aviation Support Equipment* series (GSE) (Volume 1) was written by, and with the advice of, senior AS technicians in the rating. This series replaces chapters of the three service ratings, *Aviation Support Equipment Technician's E (Electrical)* NAVEDTRA 10314-B, *M (Mechanical)* NAVEDTRA 10315-B, and *H (Hydraulic)* NAVEDTRA 10316-A. This volume as well as subsequent volumes when completed will replace other chapters of the ASE-ASM-ASH rate training manuals, until these manuals are completely deleted.

Volume 1 is the basic manual for the AS rating. It provides beginners with fundamental GSE shop organization and shop procedures. It includes the rate structure including a short history of the AS rate, supply, publications, Naval Aviation Maintenance Program and ground support equipment training. Use and identification of ground support eqipment (GSE), tools, test equipment, materials and hardware are also discussed.

Volume 2 will consist of detailed discussion of the following:

Metal-working Skills
Oxyacetylene welding
Electric Arc Welding
Inert-gas Shielded Arc Welding
Structural Maintenance and Repair
Tubing and Flexible Hose
Fluid Power Components
Hydraulics Systems Maintenance
Brakes and Brake Systems
Chassis Systems

Volume 3 consists of information on reciprocating combustion engines, gasoline engines, diesel engines, power trains, and gas turbine compressors.

Air conditioners and air condition systems will be included in a later publication for the ASE (electrician).

This volume of the RTM/NRCC was prepared by the Naval Education and Training Program Development Center, Pensacola, Florida, for the Chief of Naval Education and Training.

1981 Edition

Stock Ordering No.
0502-LP-051-6300

Published by
NAVAL EDUCATION AND TRAINING PROGRAM
DEVELOPMENT CENTER

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON, D.C.: 1981

THE UNITED STATES NAVY

GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

CONTENTS

CHAPTER Page

1. Rating Structure 1-1
2. Naval Aviation Maintenance Program (NAMP) 2-1
3. Publications 3-1
4. Aviation Supply System 4-1
5. GSE Training 5-1
6. Ground Support Equipment 6-1
7. Tools and Test Equipment 7-1
8. Hardware, Fuels, Lubricants, and Hydraulic Fluids 8-1
9. Ground Support Equipment Corrosion Control 9-1

APPENDIX

I. Acronyms AI-1

II. Definition of Terms AII-1

INDEX I-1

Nonresident Career Course follows Index

CREDITS

The illustrations indicated below are included in this edition of *Aviation Support Equipment Technician (ASE 3 & 2 and ASM 3 & 2) Volume 1, Basics,* NAVEDTRA 10325 through the courtesy of the designated company and publisher. Permission to use the illustrations is gratefully acknowledged.

SOURCE	FIGURE
Sun Electric Corporation	7-50
Black & Decker Manufacturing Company	7-59 and 7-60
Fairbanks, Morse and Company	7-63

CHAPTER 1

RATING STRUCTURE

The Aviation Support Equipment Technician (AS) rating is a relatively new rating in the U.S. Navy (1966). The first assignments to the new rating were approximately 1100 people who had been working in Ground Support Equipment shops at the time the rating was established. Most of these first Aviation Support Equipment Technicians had changed from other aviation ratings such as Aviation Structural Mechanic (AM), Aviation Machinist's Mate (AD), and Aviation Electrician's Mate (AE). Several other ratings were also represented in the initial structure. Such ratings as Boatswain's Mate (BM), Electronics Technician (ET), Machinist's Mate (MM), as well as others, were converted by BUPERS as a result of BUPERS Notice 1430 dated 18 August 1966.

When the AS class "A" schools first class was organized on 9 January 1976, there were few people in the rating. Since that time, the number of personnel has increased to approximately 2,000 men and women. However, the population has remained small when compared to other ratings such as the Aviation Structural Mechanic (AM) rating population of approximately 14,500.

COMMUNICATION AND FUNCTION

Although we are a small community, we nevertheless contribute to meeting the Navy's mission through personal pride in doing a good job and our knowledge of how important jobs are to be done well. Granted, everyone in the Navy feels that his or her job is somewhere between reasonably and extremely important, and the AS is no different in that respect. However, we are confident in the knowledge that without our equipment, our expertise, and our motivation, the aircraft could not function, could not be supported and the Navy's mission would be jeopardized.

Rating tasks range from the simple to complex. An example of a simple task is helping to tow an aircraft in and out of a hangar for maintenance. A complex task is the performing of maintenance or an operational check on such equipment as a hydraulic test stand, an electrical power unit, an air conditioner, and other complex equipment. Maintenance on this equipment and the servicing of equipment used on the flight line to get the aircraft ready for flight is performed by the AS.

OCCUPATIONAL STANDARDS

This Rate Training Module is designed as a self-study course for use by those personnel of the Navy and Naval Reserve who are preparing to meet the professional (technical) qualifications for advancement to Petty Officer Third Class and Petty Officer Second Class in the rating of Aviation Support Equipment Technician E (Electrical) and M (Mechanical, Hydraulics, and Structures). Minimum occupational requirements for advancement in all ratings are listed in the *Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards,* NAVPERS 18068 (Series). The occupational standards which were used as a guide in the preparation of this module were current as of the 1981 revision. Changes in the standards occurring after the 1981 revision may not be reflected in the information presented here.

ENLISTED RATING STRUCTURE

The present enlisted rating structure consists of general ratings and service ratings.

General ratings identify broad occupational fields of related duties and functions. Some general ratings include service ratings; others do not. Both regular Navy and Naval Reserve personnel may hold general ratings.

Service ratings identify subdivisions or specialities within a general rating which require related patterns of aptitudes and qualifications, and which provide paths of advancement for career development. The general rating provides the primary means of identifying billet requirements and personnel qualifications; it is established or disestablished by the Secretary of the Navy; and it is provided a distinctive rating badge. The general rate is the pay grade level within the general rating. Although service ratings can exist at any petty officer level, they are most common at the PO3 and PO2 levels. Both regular Navy and Naval Reserve personnel may hold service ratings. For a more detailed discussion on Navy ratings and valuable additional information which will help you do your job better and understand the Navy educational and advancement procedures, see chapter one of the *Military Requirements for Petty Officer 3 and 2,* NAVEDTRA 10056 starting with series E.

AVIATION SUPPORT EQUIPMENT TECHNICIAN (AS) RATING

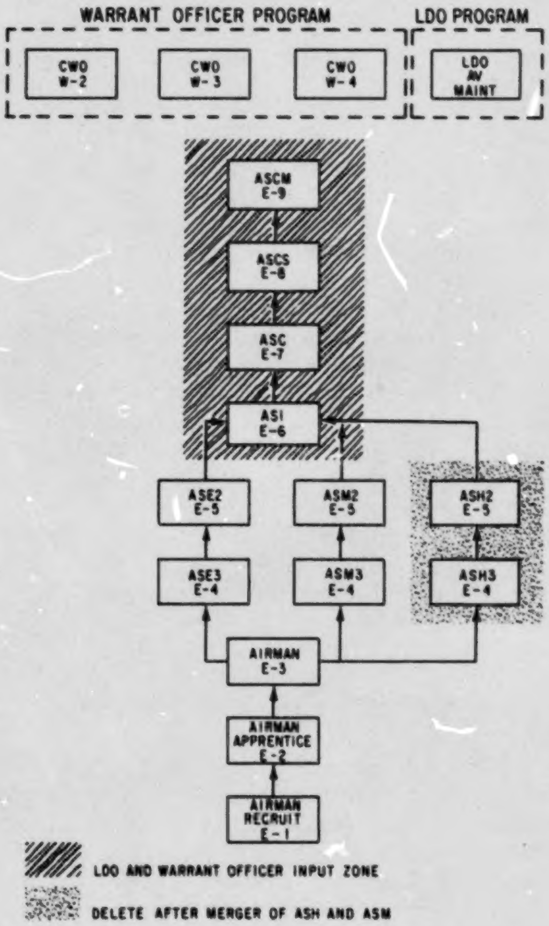
The AS rating, at the time of this writing, is divided into two service ratings at pay grades E-4 and E-5. The service ratings are ASE (Electrical), and ASM (Mechanical, Hydraulics, and Structures).

The general rating, AS, applies to paygrade E-6, where the service ratings ASE and ASM merge through E-9. Prior to this time there were three AS service ratings ASE (Electrical), ASH (Hydraulics and Structures), and ASM (Mechanical).

A study of the feasibility to consolidate the ASH and ASM service ratings was conducted and approved by Chief of Naval Operations (CNO) effective October 1980.

Figure 1-1, Paths of Advancement, illustrates the paths of advancement for an Airman Recruit to Master Chief Aviation Support Equipment Technician, Warrant Officer, or to Limited Duty Officer. Shaded areas indicate career stages where qualified enlisted personnel may advance to Warrant Officer or to Limited Duty Officer. Personnel in enlisted rates and not in shaded areas may advance only as indicated by the lines.

NOTE: The above information concerning advancement to commissioned officer status



224.1

Figure 1-1.—Paths of advancement.

applies only to the Limited Duty and Warrant Officers programs. It should be emphasized that there are other programs in which qualified personnel in pay grades E-5 and below may become commissioned officers. Consult *Military Requirements for Petty Officer 3 & 2,* NAVPERS 10056 (Series), and your local career counselor for current programs.

Aviation Support Equipment Technicians (E) service, test, and perform organizational and intermediate level maintenance and repair of: automotive electrical systems in mobile and self-propelled ground support equipment; aviation armament handling equipment, including generating, starting, lighting, and ignition systems; electrical components and wiring in auxiliary electrical power units used in servicing aircraft; electrical control systems in gas turbine compressor units and air-conditioning systems; and electrical and electronic circuits and components in general aircraft servicing equipment. They also service and maintain storage batteries and perform periodic maintenance inspections of ground support equipment.

The Aviation Support Equipment Technician (M) services, tests, and performs maintenance and repair of gasoline and diesel engines in mobile and self-propelled aviation support equipment and associated automotive systems, including fuel systems, transmissions, differentials, and steering systems; maintains gas turbine compressor units and air-conditioning systems used in servicing aircraft; maintains and operates gas turbine compressor unit test stands; and performs periodic maintenance inspections of aviation support equipment.

Prior to the merger, personnel of the Aviation Support Equipment Technician (H) rating were responsible to service, test, and perform Organizational and Intermediate level maintenance and repair of hydraulic and pneumatic systems and structural components of ground support equipment and maintain hydraulic test and service equipment, jacks, workstands, and associated equipment. Since the merger, all of these duties are performed by the ASM. The ASM also welds, cuts, shapes, and patches metal; performs structural repair and painting of ground support equipment; adjusts and repairs brake systems; inspects and replaces tires and tubes; operates and repairs hydraulic test stands; and performs maintenance inspection of ground support equipment.

As petty officers, the AS technicians are usually assigned to activities that perform intermediate level maintenance. AS billets are assigned to all aircraft carriers. AS personnel assigned aboard carriers are usually attached to the Aircraft Intermediate Maintenance Department (AIMD).

Many interesting overseas shore billets are also provided for the AS. If married, Third Class and Second Class Petty Officers may qualify to bring their dependents to these overseas locations at government expense. Shorter duty tours is usually standard procedure at a few overseas stations where dependents do not accompany the AS.

Between sea tours, the AS Third or Second Class Petty Officer may be assigned to one of the many naval air stations along the U.S. coast. In addition, the Naval Air Training Command has a few naval air stations located inland where AS personnel may be assigned. AS personnel assigned to any one of these air stations are usually attached to the Aviation Intermediate Maintenance Department (AIMD).

On sea or shore tours, you could be assigned to a squadron rather than an AIMD as most squadrons have one or more AS technicians assigned for user level support of equipment.

SOURCES OF INFORMATION

One of the more useful things you can learn about a subject is how to find out more about it. No single publication can give you all the information you need to look for accurate, authoritative, up-to-date information on all subjects related to the military requirements for advancement and the occupational standards of your rating.

Some of the publications described in this manual are subject to change or revision from time to time—some at regular intervals, others as the need arises. When using any publication that is subject to change or revision, be sure that you have the latest edition. When using any publication that is kept current by changes, be sure you have a copy in which all official changes have been made. Studying cancelled or obsolete information does not help you to perform efficiently or to advance; it is likely to be a waste of time and may even be seriously misleading.

Training films available to naval personnel are a valuable source of information on many technical subjects. Films that may be of interest to you are listed in the United States Navy Film Catalog, NAVAIR 10-10-777.

CHAPTER 2

NAVAL AVIATION MAINTENANCE PROGRAM (NAMP)

As an Aviation Support Equipment Technician (AS) or an AS striker, you are normally assigned to the Maintenance Department of a shore station or a ship. Most of your work efforts are in direct support of, or working on, ground support equipment—or maintenance. The Department of Defense (DOD) defines the term "maintenance" as ". . .the function of retaining material in, or restoring it to, a serviceable condition. Its phases include servicing, repair, modification, modernization, overhaul, rebuild, test, reclamation, inspection and condition determination, and the initial provisioning (supplying) of support items."

BACKGROUND

In the very early days of naval aviation (before 1959), it was standard practice for every aviation activity to perform its maintenance using what ever organization the commanding officer considered most expedient (convenient). Naturally, these organizations differed in varying degrees and were wasteful with manpower, money and material. Technical training of personnel was left up to the activity and provided mostly on-the-job training. With this trial-and-error plan, one method would usually prove to be the fastest and most reliable way of doing a job, but no provisions existed for determining which method was the most desirable or for providing this information to all activities concerned.

Before the NAMP operating activities were self-supporting, they were provided with all tools and equipment necessary for effecting all maintenance short of complete overhaul. Each squadron and most shops assigned to ships and stations would have a full share of tools, equipment, and machinery, such as the GSE shop, airframes, and power plants, with each shop owning a welding machine. It is evident that during a large part of the time much of this equipment was not being used. Attempts at higher levels to solve this problem led successively to the establishment of Carrier Aircraft Service Units (CASUs) and Fleet Aircraft Service Squadrons (FASRON).

Since all maintenance activities had similarities in mission, operation, and administration, it was only natural that those early planners of these activities should try to standardize the various areas as much as possible. They felt that a well organized and administered maintenance department should rank high in the following:

1. Performance and training of maintenance personnel
2. Aircraft, support equipment, and system readiness
3. Safety
4. Employment of manpower and materials
5. Planning and scheduling the workload
6. Management control of the organization
7. Evaluation of work performed
8. Combat readiness of the unit
9. Continuity when aircraft support equipment or personnel are transferred between commands.

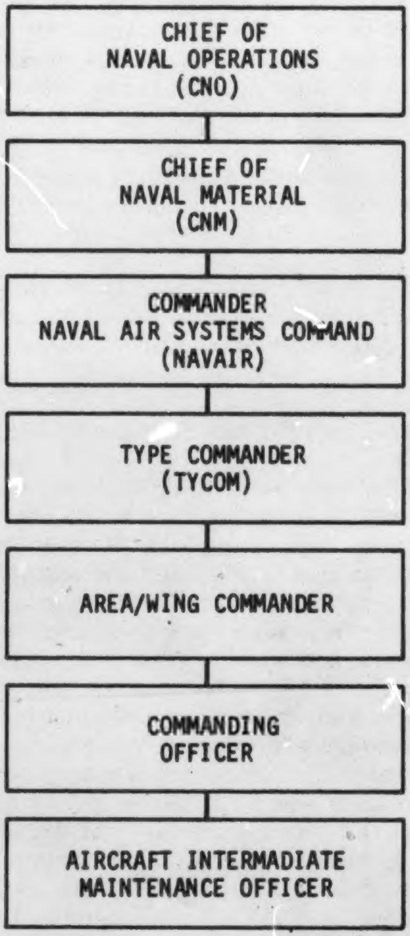
These objectives could not be attained by means of a manual or an organization structure alone. They had to be attained by the intelligent and dedicated effort of all personnel engaged in the maintenance tasks, working together toward a common goal, under the management control processes of the organization.

It was felt that specific functions of all aircraft maintenance departments should include the following:

1. Periodic maintenance and routine inspections and servicing of aircraft, associated support equipment, and aeronautical material and components, including the necessary disassembly, cleaning, examination, repair, modification, test, inspection assembly, and preservation.
2. Special work (when required) to comply with technical directives or local instructions.
3. Corrections of aircraft and equipment discrepancies.
4. Assurance of high quality in all work.
5. Maintenance of required records and technical publications.
6. Maintenance and custody of tools and other equipment provided the activity for its own use.
7. Training of assigned personnel. (Most ratings, including the AS, will have been already provided with a satisfactory theoretical background for the performance of their assigned tasks. Further training in the practical aspects of aircraft maintenance is a continuing requirement.)
8. Conducting maintenance and ground handling safety programs.
9. Submission of statistical, analytical, and historical purposes.

Out of this type of thinking grew NAMP (Naval Aviation Maintenance Program) as it is known today. The NAMP program is not a new program. It was established by the Chief of Naval Operations (CNO) and implemented in October 1959. It has been revised many times and will undoubtedly be revised many more times as new materials and new methods come along. The purpose of this chapter is to familiarize you with the Naval Aviation Maintenance Program—NAMP. You will still be getting on-the-job training and as you learn how the maintenance department is run, there is still room for new innovations, for growth, and for a person to carve a career. New ideas are always needed. To do the best you can for the Navy, for your country, and for yourself, it is necessary that you understand how aircraft maintenance is structured from where you start out as a new recruit upward to the Chief of Naval Operations.

This chapter deals with the activity that you, as an AS, are working in. Figure 2-1, Chain of Command (Maintenance), is included merely as a refresher and shows where directives come down from and where the reports and other



227.99

Figure 2-1.—Chain of command (maintenance).

activities similar to your own go up to. It is at these higher levels that your activity is coordinated with other activities similar to your own. As you study figure 2-1, you probably wonder, "Just how do I fit in?" Well, actually, you don't on this chart. This chart shows some of the major commands which exert management actions in the maintenance program. If it were extended, the Ground Support Equipment Division would be placed under the Aircraft Intermediate Maintenance Officer. It could be confusing to analyze and discuss the various functions and responsibilities of the commands shown in figure 2-1. However, you should familiarize yourself with their responsibilities and functions as outlined in the NAMP (Volume I). After reading this chapter, take some extra time to read that volume, and if parts are not clear and you do not understand them, ask your supervisor to explain them. After all, that is a part of the job of training and it shows you how you fit into the overall picture.

PURPOSE OF NAMP ORGANIZATION

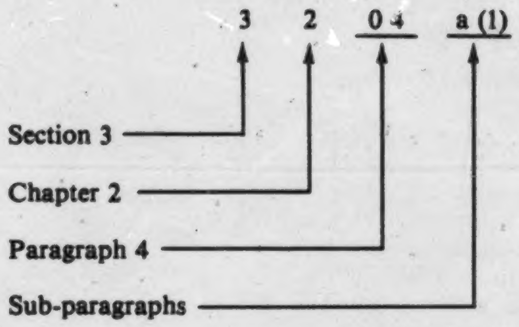
OPNAVINST 4790.2 (Series)

The Naval Aviation Maintenance Program (NAMP) as outlined in OPNAVINST 4790.2 (Series) establishes maintenance policies, procedures, and responsibilities for the performance of aviation maintenance throughout naval aviation. What this means is, that this instruction is the "law" when it comes to command, administration, and management relationships to maintenance efforts. Every job or task you perform is in some way controlled by this instruction. It is the purpose of this section to explain many of the terms, procedures, and administrative actions with which you are required not only to become familiar but in time to become an expert. A tremendous amount of paperwork (forms, maintenance actions, letters, files, memos, etc.) is associated with doing your job. However, as you get more involved with the study of this section, you will see the real necessity for these paperwork actions.

The NAMP (Naval Aviation Maintenance Program) OPNAVINST 4790.2 (Series) is sponsored and directed by the Chief of Naval Operations (CNO). It is one of the most detailed instructions with which you will be involved. This instruction is in manual form and divided into five volumes as follows:

Volume I	Concepts, Objectives, Policies, Organizations and Responsibilities
Volume II	Organizational Level Maintenance
Volume III	Intermediate Level Maintenance
Volume IV	Depot Level Maintenance
Volume V	Data Processing Requirements Manual

Each volume is divided into sections and the sections are divided into chapters. Chapters contain paragraphs and subparagraphs. Each paragraph in the instruction is numbered. The first digit identifies the section of the volume, the second digit is the chapter, and the third and fourth the paragraph. Figure 2-2 shows how paragraph 3204 a (1) is broken down. The pages are numbered in a separate series for each chapter, appendix, and index. The pages for each chapter are numbered in sequence and are preceded by the section and chapter number. The section on maintenance reporting (Volume



Each paragraph in this instruction is numbered with a unique system. The first digit identifies the section; the second, the chapter; and the third and fourth, the paragraph.

Figure 2-2.—NAMP paragraph numbering system.

III, Section 6, Chapter 4) is perhaps used by maintenance personnel more than any other part of the NAMP. If you were on page seven of the above, you would refer to it as Volume III-6-4-7.

MAINTENANCE LEVELS

Maintenance may be a task ranging from a matter of minutes of equipment servicing to a matter of months of overhaul in an industrial type facility. Basically there are three types of maintenance: Organizational Maintenance, Intermediate Maintenance, and Depot Maintenance. These maintenance levels are numbered, i.e., organizational maintenance is maintenance level 1; intermediate maintenance is maintenance level 2; and depot maintenance is maintenance level 3.

Organizational Maintenance

Organizational maintenance is the maintenance that is performed by user activities. This means that a squadron is organizational maintenance because they have the aircraft and support equipment. Their aircraft maintenance includes line operations (servicing, preflight inspections, minor adjustments, etc., in preparation for flight); periodic inspections of associated test, repairs, and adjustments which do not require shop facilities; and component removal and installation.

All naval air stations which have aircraft assigned have an operations maintenance division (OMD) that performs organizational maintenance. The Ground Support Equipment Division performs some organizational maintenance of equipment while it is at the shop.

Intermediate Maintenance

Intermediate maintenance is that type of work performed in centrally located facilities for support of operating activities within a designated area, at a base or station, or aboard aviation ships. This level of maintenance includes shop type repair and test work on aircraft, components, and equipment from the supported units. The supported units are the squadrons (Organizational Maintenance Activities) that changed the components and now the Intermediate Maintenance Activity repairs the component.

Intermediate maintenance activities are manned by a nucleus of permanently assigned personnel, and by personnel temporarily assigned from the on-board tenant squadrons. When these squadrons deploy, their intermediate maintenance personnel accompany their squadron, and are then temporarily assigned to AIMD (Aircraft Intermediate Maintenance Department) at their new station.

NOTE: The Aircraft Intermediate Maintenance Department (AIMD) is commonly referred to as the SUPPORTING activity, and the Organizational Maintenance Activity (squadron) as SUPPORTED activity. Ground Support Equipment shops are Organizational Maintenance when they are servicing and replacing components on equipment and Intermediate Maintenance when they are repairing the components.

Depot Maintenance

Depot maintenance is that type of work that must be done in an industrial type facility. Such facilities may be either military or civilian. This level of maintenance includes overhaul and major repair of modification of aircraft, components, and equipment. It also includes the manufacture of specified aeronautical parts to be stocked as spares, and the manufacture of kits for authorized aircraft and Support Equipment modification. Installation of these spare parts and the incorporation of the modification kits may be done at this level or at a lower level of maintenance. If the work is contracted to a contractor (civilian) it is still considered Depot Maintenance.

Navy Depot Maintenance activities manned primarily by civilians is known as Naval Air Rework Facility (NARF). However, some military personnel are usually assigned to NARF to assist with the intermediate and organizational work connected with the depot facility.

As you can see from the foregoing, the three maintenance levels provide for an orderly separation of the various maintenance tasks. The basis for the separation are task complexity, equipment, space requirements, skill levels of assigned personnel, and scope of support responsibility.

ORGANIZATIONAL STRUCTURE

The maintenance officer with the help of subordinate officers must manage the maintenance department and is responsible to the commanding officer for the accomplishment of the department's mission. In managing the department, the maintenance officer is responsible for:

1. Estimating and programming facilities, equipment, manpower, and training requirements
2. Functional operations such as planning, control, and production
3. Providing the direction and guidance essential for subordinate divisions to implement and comply with all local and higher authority maintenance policies and technical directives.

The standard organization structure provides for the following subordinate officers to assist the maintenance officer in the management of the department:

1. The Assistant Maintenance Officer is to supervise the activities of the staff divisions—namely, the Administrative Division, the Quality Assurance/Analysis Division, and the Maintenance/Material Control Divisions.
2. The Maintenance/Material Control Officer is to exercise direct supervision over the production divisions, power plants, avionics, armament equipment, aviator's equipment, and ground support equipment.
3. Various aircraft maintenance division officers are to organize and manage their respective divisions.

The organization for maintenance departments provides firm lines of authority from the maintenance officer to the personnel accomplishing the work for which the department is responsible. The term department is used in this training manual to mean any aircraft maintenance activity having a department head. Divisions are all major segments of the department reporting directly to the department head. In other words, divisions are subordinate to or below departments.

DIVISIONS

In the activity or department in which you are working, there are two major types of divisions. They are the Staff Division and the Production Division. Each of these two divisions have subordinate divisions.

STAFF DIVISIONS

The purpose of staff divisions is to provide services and support to production divisions, to correlate the accomplishments and progress of production divisions, and to maintain appropriate records. The administration division, the quality assurance/analysis division, and the maintenance/material control division are all staff divisions.

Administrative Division

The administrative division accomplishes the following specific functions:

1. Establishes and controls a central reporting and recordkeeping system for all maintenance reports and correspondence.
2. Implements all directives concerning distribution, retention, and disposition of records, reports, and logs.
3. Provides clerical and administrative services for the department.
4. Maintains a master message board of current messages, annotated with the action taken as appropriate, and keeps a message history file by date-time-group for a minimum of six months. It also reproduces, as necessary, and distributes incoming messages and other data.
5. Establishes and coordinates the department training requirements and obtains necessary school quotas as required.
6. Maintains correspondence files in accordance with the Navy Directives System's SECNAVINST 5210.11 (Series) by each division or branch.

7. Maintains a current organizational roster board which includes, as a minimum, name, rates, and billet assignments in conjunction with OPNAV 1000/2, Manpower authorization.
8. Supervises and coordinates department administrative responsibilities with other departments/divisions as required.
9. Safeguards and distributes personal mail to department personnel when appropriate.
10. Conducts liaison with squadron or station administration departments regarding maintenance department personnel matters.
11. Makes proper distribution of all nontechnical information and publications.
12. Distributes approved locally issued maintenance directives, procedures, reports, and studies.
13. Controls classified material required by the department.
14. Establishes proper transportation and communication systems to provide complete support of the workload.
15. Assigns spaces to the various divisions and establishes the responsibility for security and cleanliness of such spaces.

Quality Assurance/Analysis Division

The Quality Assurance/Analysis Division (QA) is the division that you, as an AS, will have more contact with than possibly any other division in the department. For this reason the (QA) division is covered quite extensively in this chapter.

Quality assurance is commonly referred to as QA. QA, as the name implies, is fundamentally that of keeping defects from affecting or interfering with work. These preventive actions cover all events from the start of a maintenance operation to its completion and is the responsibility of all maintenance personnel. The achievement of quality assurance depends on prevention, knowledge, and special skills. These goals are accomplished in two ways: (1) through statistical analysis to compare the results obtained with those desired and (2) through intensive research to find methods of improving effectiveness of the overall maintenance effort.

The major concerns of the Quality Assurance/Analysis Division include the following:

1. Safety (of both personnel and equipment).
2. The need for training maintenance personnel in the most efficient and effective methods and procedures.
3. The quality of the workmanship and materials used in maintenance.
4. The reliability of each piece of equipment and its component parts, and of the procedures used in maintenance of the equipment.
5. Qualifications of all Quality Assurance personnel, including the collateral duty inspectors.

Some of the responsibilities of the QA Division are as follows:

1. Establish qualifications for QA inspectors.
2. Reevaluate QA inspectors periodically and provide continuous on-the-job training for inspectors.
3. Ensure that all work guides, checkoff lists, check sheets, maintenance requirements cards, etc., used to define or control maintenance operations are completely current prior to issuing.
4. Review Engineering investigation requests and review all quality deficiency, safety, and publication deficiency reports to ensure that they are accurate, clear, concise, and comprehensive prior to mailing.
5. Perform work center and special audits.
6. Review all discrepancies while paying special attention to recurring discrepancies for corrective action.
7. Maintain the master Technical Library for the department.

QA usually operates with a small group of highly skilled personnel. The maintenance personnel assigned to QA Divisions are known as Quality Assurance Representatives (QARs). There is one QAR from each rate or group of related rates. The AS QAR assigned to QA should be an AS1 or above. The primary duties are GSE related.

INSPECTORS.—QA is responsible for establishing qualifications for Quality Assurance Representatives (QARs), Collateral Duty Quality Assurance Representatives (CDQARs), and Collateral Duty Inspectors (CDIs). All the personnel in these positions are approved and endorsed by their commanding officer.

QUALITY ASSURANCE REPRESENTATIVES (QARs).—Your Quality Assurance Representative (QAR), the AS assigned to the QA division, should be your main contact in QA. The GSE QAR reviews all incoming publications and directives to determine their application to GSE. The GSE QAR prepares and assists the GSE division in the preparation of maintenance instructions to assure they are what is needed to get the job done. Troubled areas in maintenance are investigated by the GSE QARs and recommendations for correcting problems are provided.

Your QAR and the QA division reviews all AS personnel that the division nominates to become CDIs or CDQARs. These inspector candidates are a very important part of a good maintenance program and must have received the recommendation of the QA Division.

COLLATERAL DUTY QARs (CDQARs).—At times there is a shortage of personnel and there is no one available to send to the QA division to be the division's QAR. In this case a collateral duty QAR (CDQAR) is assigned for a short time. An AS CDQAR would actually work in the GSE shop and also be required to perform all the functions of a QAR as though assigned to the QA Division.

COLLATERAL DUTY INSPECTORS (CDIs).—The Collateral Duty Inspectors (CDIs) are assigned to the Production Divisions (GSE is a Production Division) and are the on-the-job inspectors. The CDI is normally a PO2 or above. The CDI is certified for inspection on specified types of equipment or systems. What this means is that if a CDI is certified to inspect only electrical systems and you are working on a mechanical system, the CDI would not be able to inspect this job.

When CDIs are performing QA inspections, they are responsible to the QA officer. CDIs work directly for QA while performing inspections and for the Production Division while performing maintenance. CDIs inspect all work completed and spot check all work while it is in progress. The CDIs are required to be familiar with all programs that the QA Division monitors and manages.

Sometimes there is a shortage of CDI and workers in the division and the CDIs are left to inspect their own work. This is a big "no-no". The OPNAVINST 4790.2 (Series) is very clear about CDIs NOT inspecting their own work. It states, "NO CDI MAY INSPECT HIS OWN WORK AND SIGN AS INSPECTOR." When a CDI performs maintenance and there is no other CDI to inspect the work, the QAR does the inspecting.

QUALITY ASSURANCE AUDITS.—As the name implies, audits serve to provide an evaluation of the Maintenance Department and are conducted by the QA Division. There are two types of audits—work center audits and special audits.

Work Center Audits.—Work Center Audits are conducted quarterly to evaluate the overall quality performance of each work center in the department. Some of the areas checked by the audit are:

1. Number of personnel assigned to the division and their skill levels; this ensures that the division can perform the assigned jobs.

2. The division Technical Publications Library which ensures that all publications are on hand to perform the division's mission. They are also checked to ensure that all changes are incorporated and that the publications are in good physical condition.

3. All maintenance instructions, other directives, and inspections procedures for compliance with regulations to determine if there are adequate written processing, testing, and inspection procedures for all equipment in the work spaces. Also to determine if they are being used.

4. The calibration of test equipment, gages, torque wrenches, and other equipment to ensure that proper use of this equipment is accomplished.

5. The ground support equipment licensing and training program to ensure that it is conducted in accordance with existing directives.

6. The work area for compliance with all safety regulations and cleanliness standards. All paperwork areas are to be inspected.

Special Audit.—In addition to the scheduled work center audit, there is a special audit to evaluate a specific maintenance task. The work center audit checks for unknown problems—the special audit is used to help correct a known problem area. For example, during a work center audit, it was found that the GSE tool control program was not operating as it should. After a reasonable time the QA officer directs a special audit to see if the GSE has resolved the problem.

ANALYST RESPONSIBILITIES.—The Quality Assurance/Analysis Division provides sound and sufficient analytical information to the maintenance officer to enable continual review of management practices within the organization. A Quality Assurance/Analysis Division is established to monitor, control, and apply the Maintenance Data System (MDS) within that activity. This division serves as a contact point between the work center and the Data Services Facility and is responsible for all aspects of the MDS at the activity level.

Quality Assurance/Analysis functions are regularly assigned to personnel of the AZ rating. The analysis section normally consists of one senior petty officer who must be formally trained in the MDS procedures, data processing capabilities and the techniques of statistical analysis. The analyst reviews and analyzes reports on information of benefit to the maintenance activity and which is produced by the MDS.

The general responsibility of the analysis section is to extract and examine pertinent data from the MDS reports. The results are then presented in chart, tabular, or graphic form for easy viewing. (In GSE you see this in the form of a summary.) The requirements for analysis may stem from various sources and apply to a wide range of maintenance subjects. In some instances, analysis may be initiated to provide an answer to a specific problem. In other instances, analysis of selected areas of maintenance (for example, personnel utilization or productivity of work centers) may be initiated as a monitoring action.

TECHNICAL PUBLICATIONS LIBRARY (TPL).—QA maintains the master Technical Library for the Maintenance Department. This includes all maintenance publications, maintenance related publications, technical directives, and maintenance requirements cards (MRCs).

They ensure that each division receives all applicable material and that it is kept current and complete. The Technical Publication Library (TPL) will be discussed further in the publication chapter of this module.

Maintenance/Material Control Division

As stated previously, the Maintenance/Material Control Division is one of the major staff elements in the Maintenance organization. The officer in charge of this division is also the assistant to the maintenance officer. He exercises authority in a position between the maintenance officer and the production divisions. He therefore is directly responsible to the maintenance officer for the overall productive effort and the material support of the department.

The functions performed by Maintenance/Material Control Division is divided into two work centers—one is the maintenance control functions and the other is the material control functions.

MAINTENANCE CONTROL FUNCTIONS.—Maintenance Production Control is the central control of the entire maintenance effort. This control function is accomplished primarily by proper planning, scheduling, and assignment of the various maintenance tasks performed within the maintenance department.

Intermediate Maintenance activities exist primarily for the purpose of supporting operating activities; therefore the personnel working in the production control work center are concerned with the procedures involved in planning and scheduling the workload which consists of repairing, testing, and processing aircraft parts, components, and ground support equipment. Due to the size of an intermediate activity, the location of the various work centers, and the number of components involved daily, it is not practical to control each component inducted into the activity from a central production control area. Production control delegates some of its functions to certain selected production divisions such as the GSE division. Divisions so designated exercise direct control of the production efforts of assigned work centers. Such divisions are responsible to maintenance control for the production efforts of the assigned work centers, scheduling components into work centers, and assigning priorities as directed by production control.

Production control cooperates with the staff members by applying their findings and recommendations to improve the overall maintenance efforts. Together with the administration division, the quality assurance division, and the analysis section, maintenance/material control provides the maintenance officer with a complete picture of the maintenance situation as it exists at any given time, and makes recommendations for improvement.

MATERIAL CONTROL FUNCTIONS.—The material control work center coordinates and controls the supply functions of the department. It acts as liaison between the department and the local supply activity, and it processes all supply and material transactions for the other divisions of the department. It requisitions material, maintains the material control register, maintains inventories of materials on hand, maintains subcustody records of accountable items held by the department, maintains records of all material transactions, and accounts for the expenditure of funds by the department. It furnishes technical advice and information to the local supply activity concerning material requirements for the assigned workload.

The material control work center of intermediate maintenance activities has an aeronautical material screening unit which coordinates the screening of received materials and parts to determine the status and repair responsibility/capability.

PRODUCTION DIVISIONS

The standard organization framework for intermediate maintenance activities provides for six production divisions as shown in figure 2-3.—Intermediate Level Department Organization (Ashore). The production control work center in this figure is the overall coordinator for all division production segments. The entire responsibility for production of the department is controlled by the production control work center. The production divisions are generally manned by personnel of the same rating, in contrast to organizational maintenance departments where personnel of more than one rating are grouped into fewer divisions. The type of work usually performed by an individual is the same regardless of the maintenance level at which a person is working; that is, ADs work on engines and related equipment, AEs on instruments and electrical equipment, and ASs work on ground support equipment. The difference between work performed in production divisions at various maintenance levels lies in the depth of maintenance performed.

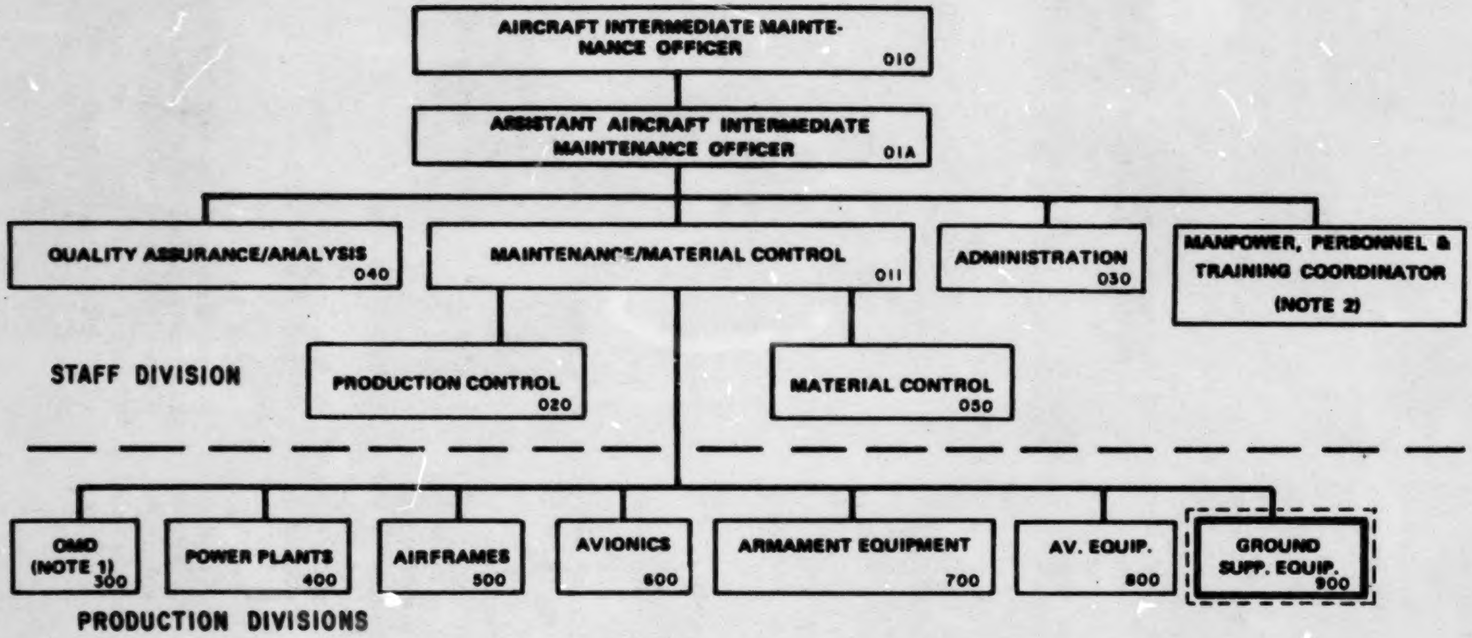
These production divisions provide intermediate maintenance on aircraft components and equipment for the supported activities. These divisions and some of their more important responsibilities and functions are described below.

Powerplants Division

The powerplants division is manned by Aviation Machinist's Mates (ADs) who perform maintenance on powerplants, powerplant components, and associated systems.

Airframes Division

Aviation Structural Mechanics (AMs) are assigned to work centers in the airframes division. This division is responsible for the specified level of maintenance of the airframe and structural components; movable structures and surfaces including their hydraulic and pneumatic control and actuating systems and mechanisms; air-conditioning, pressurization, visual improvement, oxygen, and other utility systems.


AIRCRAFT INTERMEDIATE MAINTENANCE OFFICER 010
ASSISTANT AIRCRAFT INTERMEDIATE MAINTENANCE OFFICER 01A
QUALITY ASSURANCE/ANALYSIS 040
MAINTENANCE/MATERIAL CONTROL 011
ADMINISTRATION 030
MANPOWER, PERSONNEL & TRAINING COORDINATOR (NOTE 2)
STAFF DIVISION
PRODUCTION CONTROL 020
MATERIAL CONTROL 050
OMD (NOTE 1) 300
POWER PLANTS 400
AIRFRAMES 500
AVIONICS 600
ARMAMENT EQUIPMENT 700
AV. EQUIP. 800
GROUND SUPP. EQUIP. 900
PRODUCTION DIVISIONS

NOTE 1: WHEN SPECIFIC AUTHORITY HAS BEEN GRANTED TO COMBINE THE OMD AND IMA, AN ORGANIZATIONAL MAINTENANCE DIVISION WILL BE ESTABLISHED.

NOTE 2: FOR AIMD's NOT LARGE ENOUGH TO RATE THE E–9 BILLET ASSOCIATED WITH THIS FUNCTION, AND IN THOSE CASES WHERE FULL E–9 AND E–8 MANNING IS NOT AVAILABLE, THIS SEPARATE ORGANIZATIONAL POSITION IS NOT REQUIRED.

234.102A

Figure 2-3.—Intermediate level maintenance department organization (ashore).

Avionics Division

The avionics division is manned with the appropriate combination of the following ratings to provide maintenance of avionics equipment for the supported activities: (1) Aviation Electrician's Mates (AEs) maintain aircraft electrical and instrument systems; (2) Aviation Electronics Technician (ATs) maintain and test aviation electronic equipment, including detection, reconnaissance, identification, communication, navigation, display, and special purpose equipment.

Armament Equipment Division

Aviation Ordnanceman (AO) are assigned to the armament equipment division and are responsible for maintenance of aircraft armament equipment and aviation ordnance equipment.

Ground Support Equipment Division

The Aviation Support Equipment Technician (AS) performs the necessary maintenance on the GSE assigned to the maintenance department and supported activities. GSE includes such items as test stands, workstands, mobile electric powerplants, and pneumatic and hydraulic servicing equipment and other equipment needed to support aircraft.

Aviators Equipment Division

The Aircrew Survival Equipmentman (PR) is assigned to the Aviators Equipment Division and maintains parachutes, survival equipment, flight clothing, aircraft oxygen components, and related equipment.

NOTE: The various divisions afloat are similar to those ashore in the production division. This similarity can be seen in figure 2-4 when you compare it with figure 2-3.

MAINTENANCE

There are two types of maintenance actions that you as an AS will be performing. These actions are scheduled and unscheduled maintenance. Scheduled, being maintenance that is known and programmed to be accomplished (inspections). Unscheduled maintenance is that maintenance that is required because of a failure of GSE.

Scheduled Maintenance

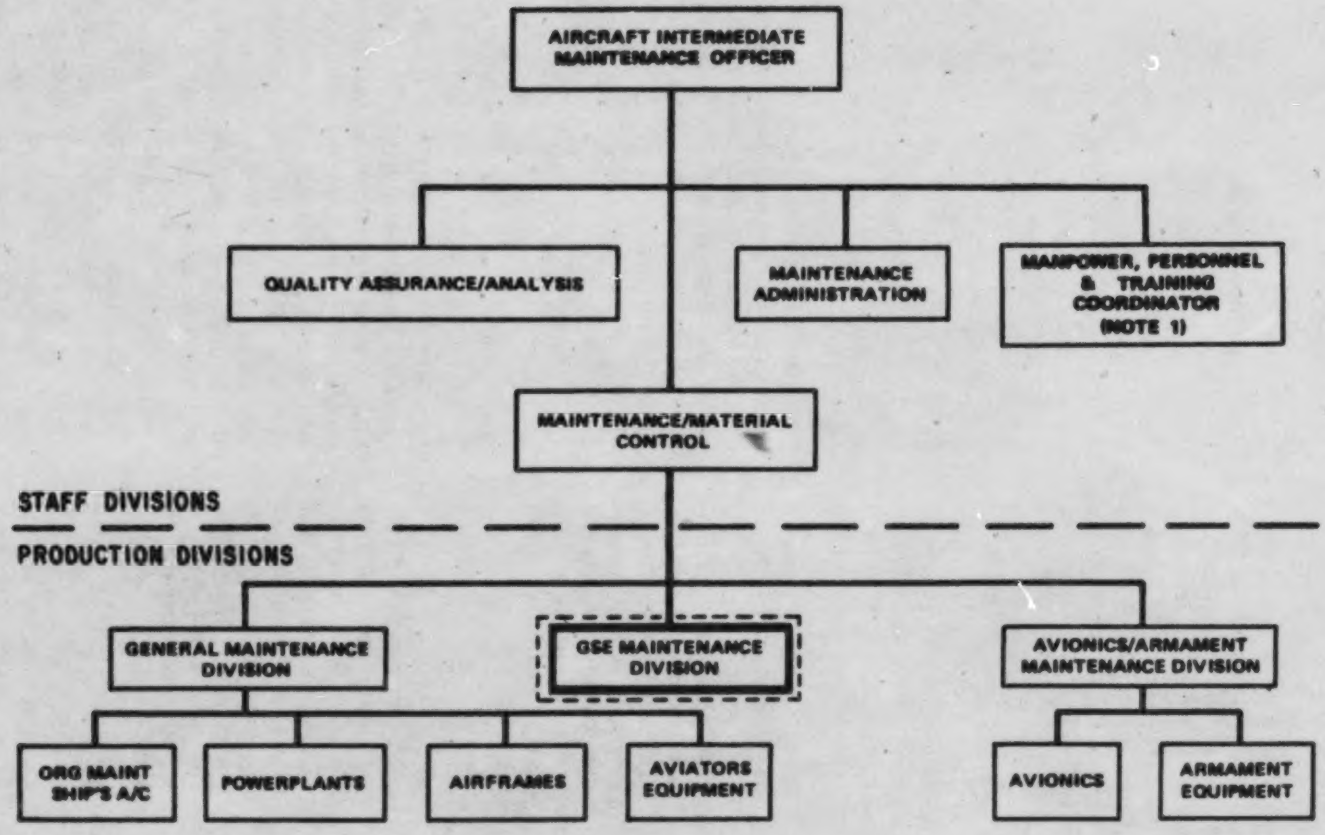
In order to have an effective scheduled maintenance program you must have Maintenance Requirements Cards (MRCs). The MRCs provide the maintenance tasks required to maintain Ground Support Equipment in an effective operational condition. The MRCs are only for the look phase of inspection. GSE scheduled maintenance program contains MRCs for Preoperational Inspections, Periodic Inspections, Acceptance Inspections, and Transfer Inspections. MRCs do not include instruction for repair, adjusting or making corrective action on equipment.

PREOPERATIONAL INSPECTIONS.—Preoperational Inspections are performed to ensure that equipment is serviced and/or functional and ready for use. This inspection is performed prior to the first operation of the day and/or before each use.

PERIODIC INSPECTIONS.—Periodic Inspections provide requirements to ensure that a thorough examination of equipment is performed in increments of weeks. Operation hours, starts and/or use will control the number of weeks between periodic inspections.

ACCEPTANCE INSPECTIONS.—The Acceptance Inspection is performed at the time GSE accepts a newly assigned item of equipment. You can use preoperational MRCs or periodic MRCs for this inspection, depending on the local GSE division. An inventory will be completed along with the inspection to ensure that all history records and forms are received with the equipment.

TRANSFER INSPECTIONS.—The Transfer Inspections are basically the same as acceptance inspections. They are completed by the GSE that is transferring the equipment to another command's GSE. The Transfer and Acceptance Inspections are only performed when equipment is transferred from one GSE to another GSE, not from GSE to a user activity.


AIRCRAFT INTERMEDIATE MAINTENANCE OFFICER
QUALITY ASSURANCE/ANALYSIS
MAINTENANCE ADMINISTRATION
MANPOWER, PERSONNEL & TRAINING COORDINATOR (NOTE 1)
MAINTENANCE/MATERIAL CONTROL
STAFF DIVISIONS
PRODUCTION DIVISIONS
GENERAL MAINTENANCE DIVISION
GSE MAINTENANCE DIVISION
AVIONICS/ARMAMENT MAINTENANCE DIVISION
ORG MAINT SHIP'S A/C
POWERPLANTS
AIRFRAMES
AVIATORS EQUIPMENT
AVIONICS
ARMAMENT EQUIPMENT

NOTE 1: AUTHORIZED FOR CVs ONLY

234.102B

Figure 2-4.—Intermediate level maintenance department organization (afloat).

Unscheduled Maintenance

Unscheduled maintenance is just what the name implies. You might say that it is repair that was not anticipated. Obviously the better job that is done on scheduled maintenance, the less likely you are to have unscheduled maintenance.

EQUIPMENT RECORDS

To ensure an accurate maintenance history of each item of ground support equipment for which Maintenance Requirements Cards (MRCs) are provided, three records must be maintained. These are (1) GSE Custody and Maintenance Record, (2) GSE Sub-Custody and Periodic Maintenance Record, and (3) GSE Daily Record.

GSE Custody and Maintenance Record

The GSE Custody and Maintenance Record, OPNAV Form 4790/51, illustrated in figure 2-5 is maintained by the supporting or using activity accountable for and having prime custody of each unit of equipment. Entries on this form are made, as required, in order to provide a maintenance history. A record is maintained on each unit of support equipment until the unit is retired.

The front of this form is divided into four major sections. The first section is used to record acceptance information; the second is a custody and transfer record; the third is the rework record; and the fourth section is the preservation/depreservation record.

The back of this form is divided into two major sections. The first section is used to record replacement of major parts, and the second is used to record the incorporation of technical directives.

GSE Sub-Custody and Periodic Maintenance Record

The GSE Sub-Custody and Periodic Maintenance Record, OPNAV Form 4790/50, illustrated in figure 2-6, is maintained on each applicable unit of support equipment by the supporting or using activity.

The front of the form is used to record basic item identification and sub-custody information. The back of the form is used to record operating and periodic maintenance information. It also contains instructions for use of the form. Entries are made on the periodic maintenance record by the activity having prime custody of the equipment, and by those who loaned such equipment on a sub-custody basis.

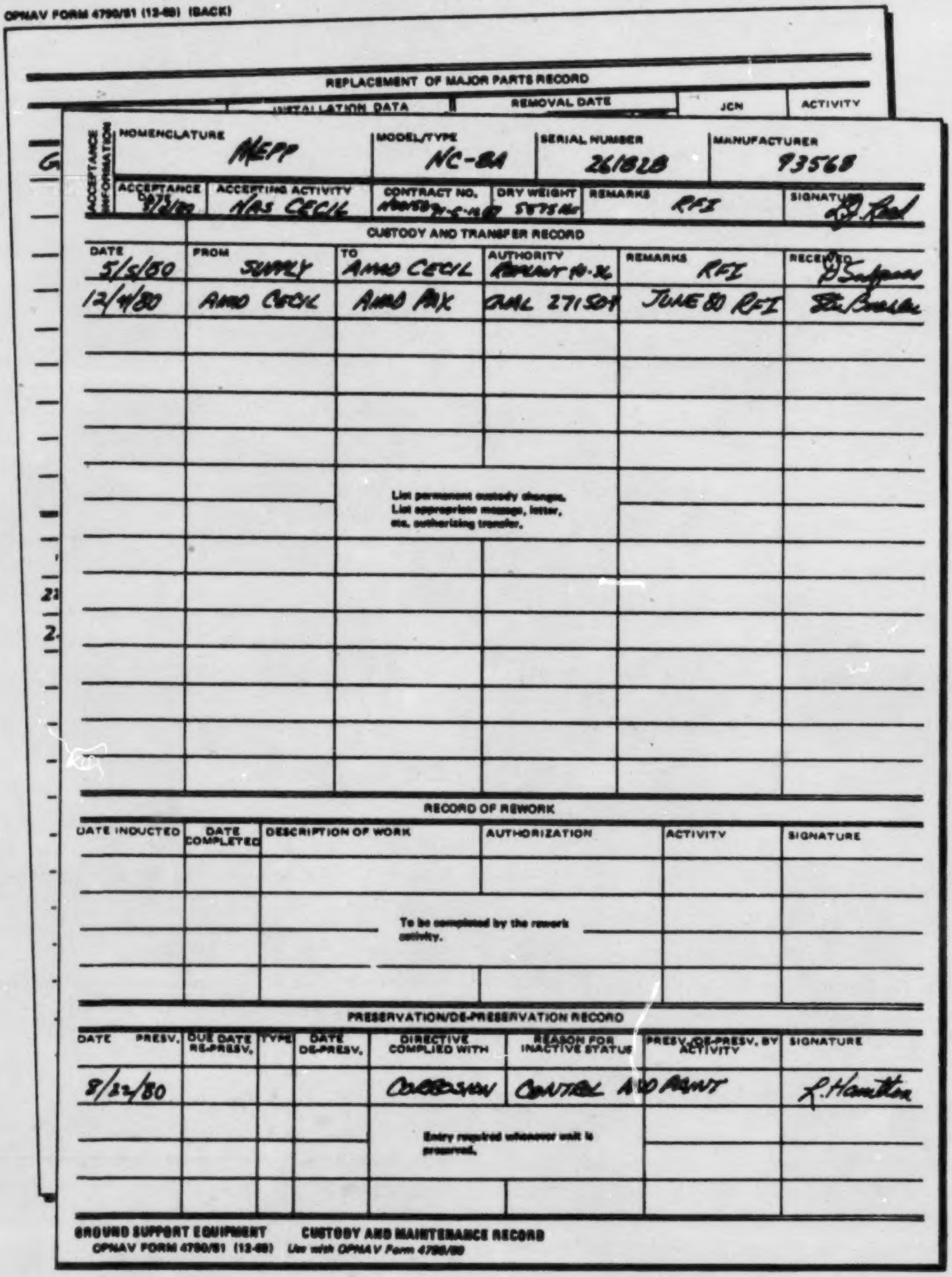
For the most part, the column headings on this form are self-explanatory. On the sub-custody record in the column titled Data Due for PM (periodic maintenance) enter the date on which scheduled maintenance is due. The equipment is returned to the prime custodian for the accomplishment of periodic maintenance.

On the periodic maintenance record, the columns titled Hours and Starts are used to record operating data. Some types of support equipment have hour meters to register operating time, and some have start meters to register the number of starts since, in some cases, starts are more significant from a usage standpoint than actual running or operating time. Other types of support equipment have no provisions for registering operating time; therefore, the user of the equipment must keep account of daily usage.

GSE Daily Record

A Ground Support Equipment Daily Record, OPNAV Form 4790/52, illustrated in figure 2-7 is maintained by the using activity for each item of support equipment. This form is kept with the equipment in a suitable container. Entries are made to reflect all preoperational (daily) maintenance performed. Additionally, this form is used to record all operating times for units not equipped with meters. Operating times are logged as hours/starts as appropriate.

The current GSE Support Equipment Custody and Maintenance Record and the GSE Sub-Custody and Periodic Maintenance Form accompany the equipment when transferred between activities on a permanent basis. All three forms are available through local supply activities as listed in NAVSUP Publication 2002, Section II.



OPNAV FORM 4790/51 (12-69) (BACK)

REPLACEMENT OF MAJOR PARTS RECORD

INSTALLATION DATA	REMOVAL DATE	JCN	ACTIVITY

ACCEPTANCE INFORMATION

NOMENCLATURE	MODEL/TYPE	SERIAL NUMBER	MANUFACTURER
MEPP	NC-8A	261828	93568

ACCEPTANCE DATE	ACCEPTING ACTIVITY	CONTRACT NO.	DRY WEIGHT	REMARKS	SIGNATURE
[illegible]	NAS CECIL	[illegible]	5875 lbs	RFI	

CUSTODY AND TRANSFER RECORD

DATE	FROM	TO	AUTHORITY	REMARKS	RECEIVED
5/5/80	SUPPLY	AIMD CECIL	[illegible] 10-36	RFI	
12/4/80	AIMD CECIL	AIMD PAX	GMAL 271504	JUNE 80 RFI	

List permanent custody changes. List appropriate message, letter, etc. authorizing transfer.

RECORD OF REWORK

DATE INDUCTED	DATE COMPLETED	DESCRIPTION OF WORK	AUTHORIZATION	ACTIVITY	SIGNATURE

To be completed by the rework activity.

PRESERVATION/DE-PRESERVATION RECORD

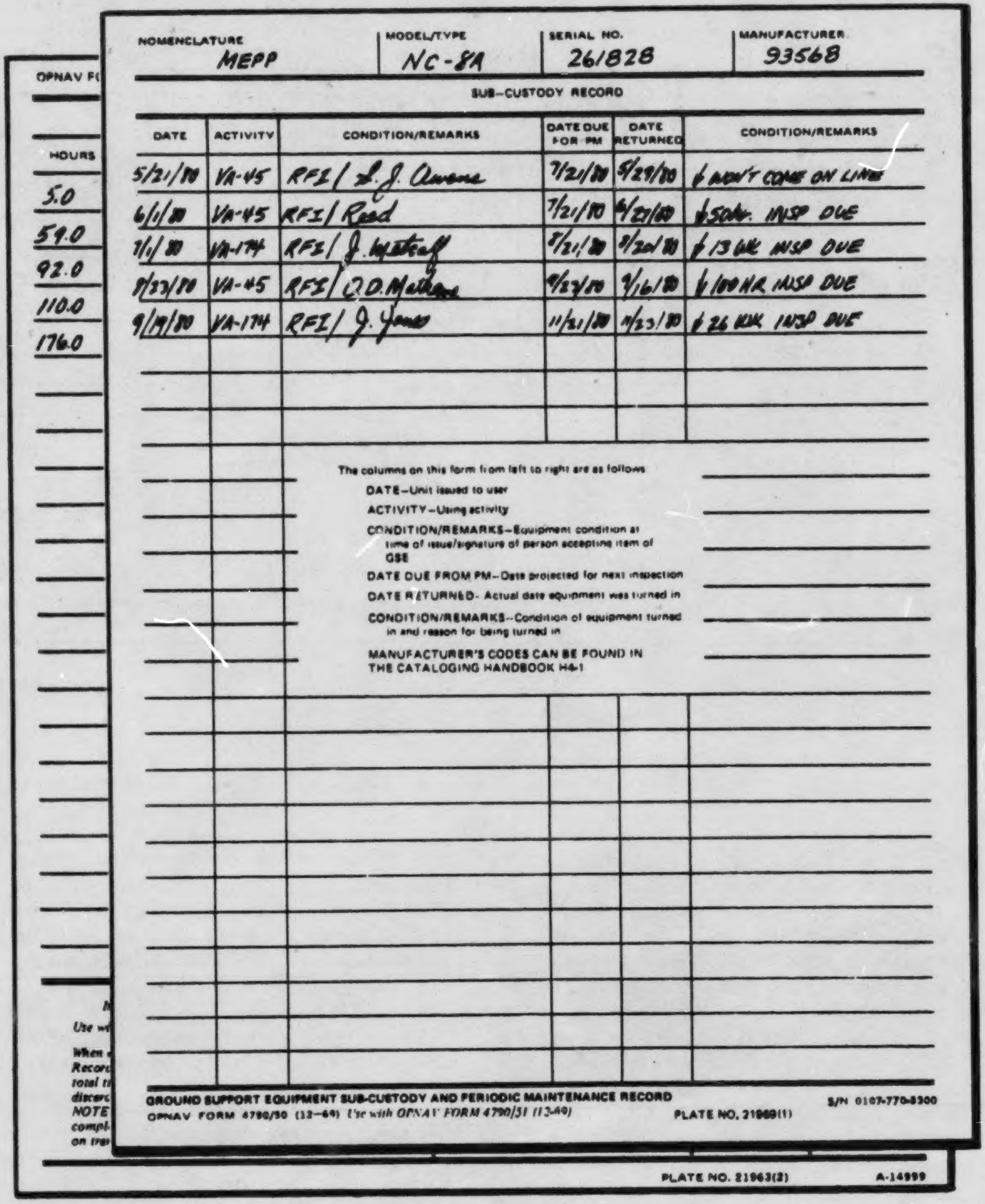
DATE PRESV.	DUE DATE RE-PRESV.	TYPE	DATE DE-PRESV.	DIRECTIVE COMPLIED WITH	REASON FOR INACTIVE STATUS	PRESV./DE-PRESV. BY ACTIVITY	SIGNATURE
8/22/80				CORROSION	CONTROL AND PAINT		L. Hamilton

Entry required whenever unit is preserved.

GROUND SUPPORT EQUIPMENT CUSTODY AND MAINTENANCE RECORD
OPNAV FORM 4790/51 (12-69) *Use with OPNAV Form 4790/50*

234.147

Figure 2-5.—GSE custody and maintenance record OPNAV Form 4790/51.



OPNAV F

HOURS
5.0
59.0
92.0
110.0
176.0

NOMENCLATURE	MODEL/TYPE	SERIAL NO.	MANUFACTURER
MEPP	NC-8A	261828	93568

SUB-CUSTODY RECORD

DATE	ACTIVITY	CONDITION/REMARKS	DATE DUE FOR PM	DATE RETURNED	CONDITION/REMARKS
5/21/80	VA-45	RFI/ S. J. [illegible]	7/21/80	5/29/80	Ø WON'T COME ON LINE
6/1/80	VA-45	RFI/ Reed	7/21/80	6/27/80	Ø 50hr. INSP DUE
7/1/80	VA-174	RFI/ J. Metcalf	8/21/80	8/20/80	Ø 13 WK INSP DUE
8/23/80	VA-45	RFI/ C.D. Mathews	9/23/80	9/16/80	Ø 100 HR. INSP DUE
9/19/80	VA-174	RFI/ J. Jones	11/21/80	11/23/80	Ø 26 WK. INSP DUE

The columns on this form from left to right are as follows

DATE—Unit issued to user

ACTIVITY—Using activity

CONDITION/REMARKS—Equipment condition at time of issue/signature of person accepting item of GSE

DATE DUE FROM PM—Date projected for next inspection

DATE RETURNED- Actual date equipment was turned in

CONDITION/REMARKS--Condition of equipment turned in and reason for being turned in

MANUFACTURER'S CODES CAN BE FOUND IN THE CATALOGING HANDBOOK H4-1

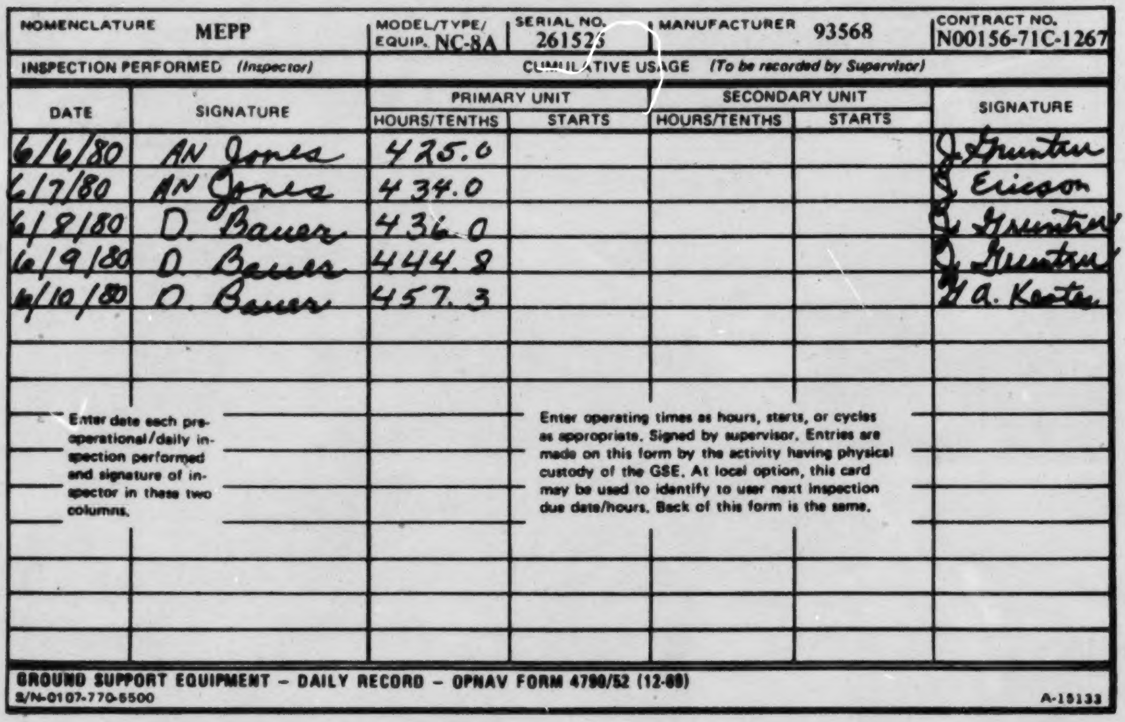
GROUND SUPPORT EQUIPMENT SUB-CUSTODY AND PERIODIC MAINTENANCE RECORD

OPNAV FORM 4790/50 (12-69) *Use with OPNAV FORM 4790/51 (12-69)* PLATE NO. 21969(1) S/N 0107-770-8300

PLATE NO. 21963(2) A-14999

234.146

Figure 2-6.—GSE sub-custody and periodic maintenance. OPNAV Form 4790/50.



NOMENCLATURE MEPP
MODEL/TYPE/EQUIP. NC-8A
SERIAL NO. 261525
MANUFACTURER 93568
CONTRACT NO. N00156-71C-1267

INSPECTION PERFORMED (Inspector)		CUMULATIVE USAGE (To be recorded by Supervisor)				
		PRIMARY UNIT		SECONDARY UNIT		
DATE	SIGNATURE	HOURS/TENTHS	STARTS	HOURS/TENTHS	STARTS	SIGNATURE
6/6/80	AN Jones	425.0				J. Grunter
6/7/80	AN Jones	434.0				J. Ericson
6/8/80	D. Bauer	436.0				J. Grunter
6/9/80	D. Bauer	444.8				J. Grunter
6/10/80	D. Bauer	457.3				H. A. Koster

Enter date each preoperational/daily inspection performed and signature of inspector in these two columns.

Enter operating times as hours, starts, or cycles as appropriate. Signed by supervisor. Entries are made on this form by the activity having physical custody of the GSE. At local option, this card may be used to identify to user next inspection due date/hours. Back of this form is the same.

GROUND SUPPORT EQUIPMENT – DAILY RECORD – OPNAV FORM 4790/52 (12-69)
S/N-0107-770-5500
A-15133

234.145

Figure 2-7.—GSE daily record OPNAV 4790/52.

MAINTENANCE DATA REPORTING

Various forms are required to enable maintenance activities to schedule daily maintenance requirements, assign work in a preplanned manner, establish responsibility for work performed, and record replacement and discrepancies discovered, as well as corrective action taken. The following paragraphs cover some of the forms which you, as an AS, may come in contact with in your day-to-day duties.

Maintenance data must be recorded in such a manner that it will be adaptable to accounting machine processing. Therefore, much of the information that maintenance personnel enter on maintenance forms must be in the form of codes. The maintenance forms are processed through a key punch operation, and the information is punched into accounting machine cards. These cards are then processed to produce reports for use in the management and improvement of the maintenance, material, supply, and equipment design function. It is, therefore, important that all coded information entered on the maintenance forms be accurate and clearly written so that key punch machine operators can read and enter the information correctly on the punched cards. The reports produced are significant and useful only if the codes are carefully selected and accurate.

Some terms must be understood before we discuss the codes. These items are as follows:

End Item. An end item, for the purpose of Maintenance Data Reports (MDR) is a final combination of products, components, parts, and/or other materials with a designed use. An example of an end item is an NC-2A power unit.

Maintenance Action. A maintenance action is any corrective or preventive action taken to maintain or restore equipment or material to a satisfactory operating condition. This action consumes man-hours or material, or both.

On-Equipment Work. Maintenance actions performed on complete end items (i.e., aircraft, drones, ground support equipment units, etc.) are considered as on-equipment work.

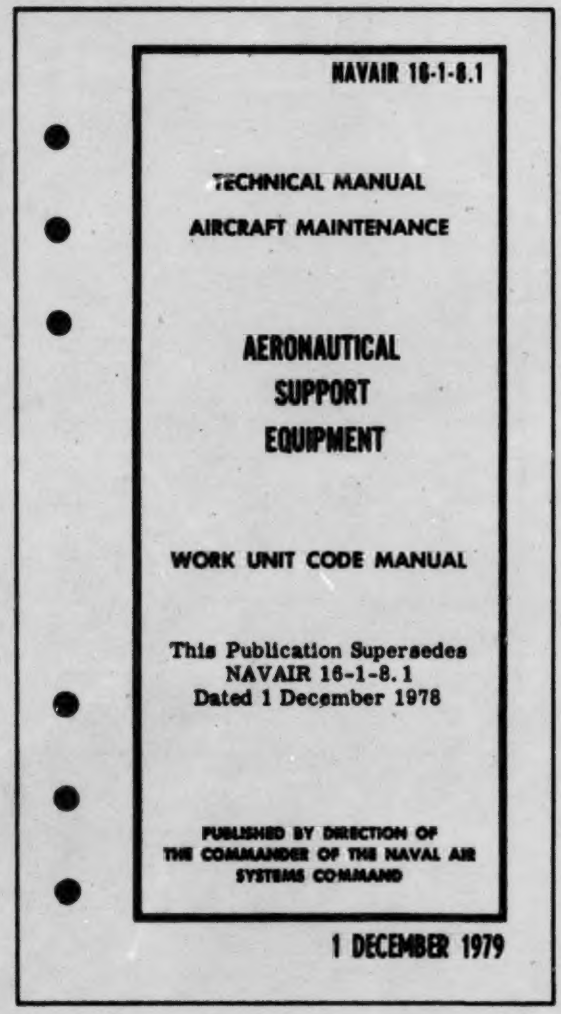
Off-Equipment Work. Maintenance actions performed on removed repairable components (usually at the AIMD/IMA) are considered as off-equipment work.

Most of the codes required are listed and defined in OPNAV Instruction 4790.2 (Series), The Naval Aviation Maintenance Program. However, work unit codes vary from one model of Ground Support Equipment (GSE) to another. Therefore, these codes are provided in figure 2-8, WUC manual, NAVAIR 16-1-8.1 for GSE. In addition, most of the other codes commonly used by maintenance personnel are included. The manual is issued in pocket size for your convenience. Brief descriptions of these codes are presented as follows:

Work Unit Code (WUC). A five- or seven-character numeric or alphabetic numeric code which normally identifies the system, subsystem, assembly, component, etc., on which maintenance is being performed. The first two characters are system codes (Codes 1 through 49 and 92 are GSE codes).

The five character code is normally used for "on equipment" maintenance work. The number 9 is used in the fifth digit position to indicate "not otherwise coded" (NOC). The NOC is used only when there is no other code that could be used.

The seven character code is an expansion of the basic five character code to identify further breakdown of components to lower levels of assembly. In figure 2-9 work unit codes for a NC-8A mobile electric power plant system (code 44) are indicated in the outlined area. As can be seen 44FMO (figure 2-9) is the NC-8A power unit. The 44FM800 shown in this figure is the control box assembly. The control box is further broken down to 44FM820 which is the AC voltage regulator and 44FM821 which is the circuit board in the voltage regulator.



NAVAIR 16-1-8.1

TECHNICAL MANUAL
AIRCRAFT MAINTENANCE

AERONAUTICAL
SUPPORT
EQUIPMENT

WORK UNIT CODE MANUAL

This Publication Supersedes
NAVAIR 16-1-8.1
Dated 1 December 1978

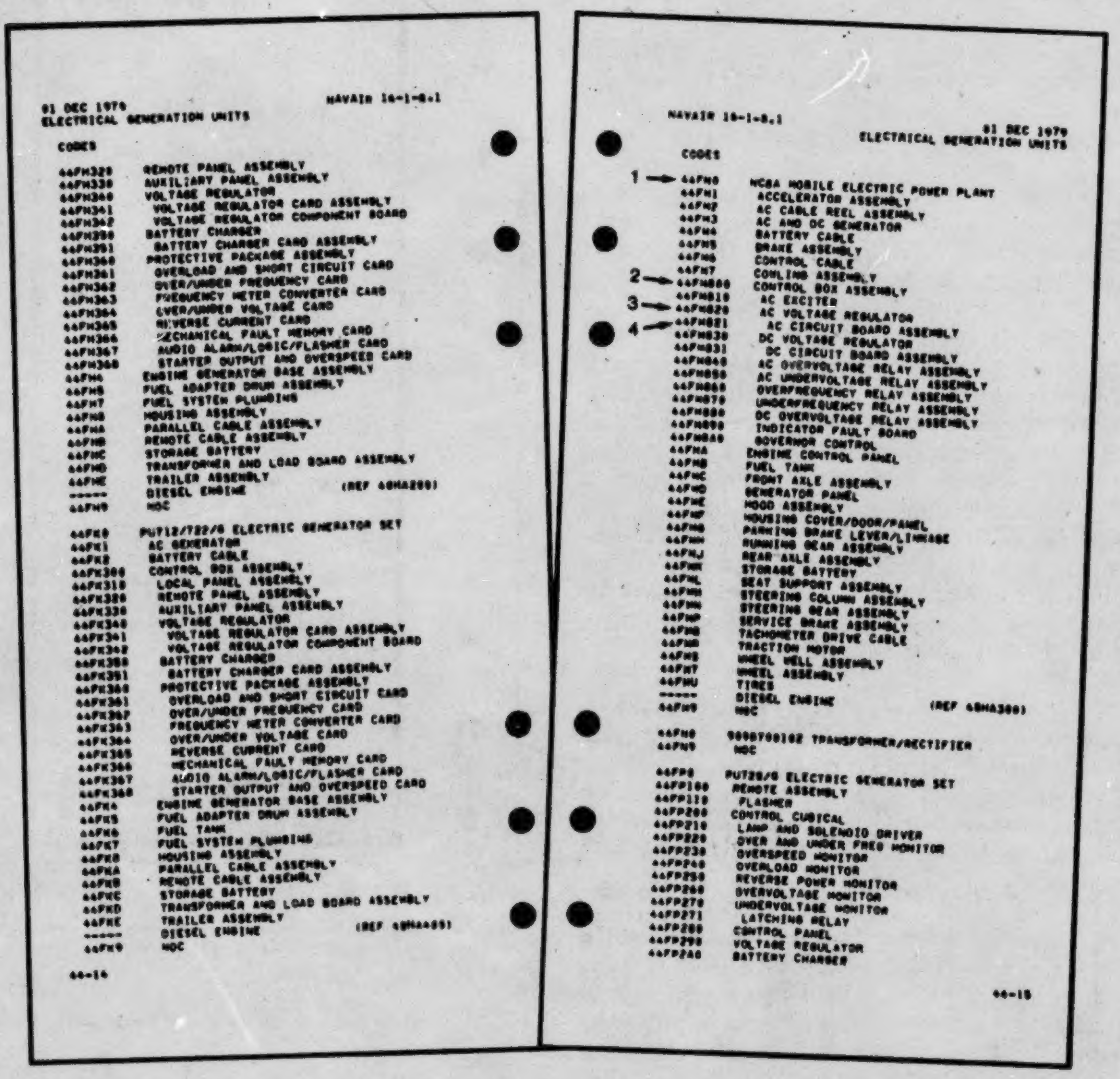
PUBLISHED BY DIRECTION OF
THE COMMANDER OF THE NAVAL AIR
SYSTEMS COMMAND

1 DECEMBER 1979

227.100

Figure 2-8.—Work unit code manual.

Malfunction Description Code. This code consists of three numeric characters and is used to describe equipment malfunction. Conditional malfunction codes, a part of Malfunction Description Codes, are those which describe a malfunction caused by battle damage, improper maintenance/handling, improper operation of associated equipment, etc. In the WUC manual,



```
01 DEC 1979                                NAVAIR 16-1-8.1
ELECTRICAL GENERATION UNITS

  CODES

  44FH320    REMOTE PANEL ASSEMBLY
  44FH330    AUXILIARY PANEL ASSEMBLY
  44FH340    VOLTAGE REGULATOR
  44FH341     VOLTAGE REGULATOR CARD ASSEMBLY
  44FH342     VOLTAGE REGULATOR COMPONENT BOARD
  44FH350    BATTERY CHARGER
  44FH351     BATTERY CHARGER CARD ASSEMBLY
  44FH360    PROTECTIVE PACKAGE ASSEMBLY
  44FH361     OVERLOAD AND SHORT CIRCUIT CARD
  44FH362     OVER/UNDER FREQUENCY CARD
  44FH363     FREQUENCY METER CONVERTER CARD
  44FH364     OVER/UNDER VOLTAGE CARD
  44FH365     REVERSE CURRENT CARD
  44FH366     MECHANICAL FAULT MEMORY CARD
  44FH367     AUDIO ALARM/LOGIC/FLASHER CARD
  44FH368     STARTER OUTPUT AND OVERSPEED CARD
  44FH4      ENGINE GENERATOR BASE ASSEMBLY
  44FH5      FUEL ADAPTER DRUM ASSEMBLY
  44FH7      FUEL SYSTEM PLUMBING
  44FH8      HOUSING ASSEMBLY
  44FHA      PARALLEL CABLE ASSEMBLY
  44FHB      REMOTE CABLE ASSEMBLY
  44FHC      STORAGE BATTERY
  44FHD      TRANSFORMER AND LOAD BOARD ASSEMBLY
  44FHE      TRAILER ASSEMBLY
  ------     DIESEL ENGINE                 (REF 46HA200)
  44FH9      NOC

  44FK0      PUT12/T22/G ELECTRIC GENERATOR SET
  44FK1       AC GENERATOR
  44FK2       BATTERY CABLE
  44FK300     CONTROL BOX ASSEMBLY
  44FK310      LOCAL PANEL ASSEMBLY
  44FK320      REMOTE PANEL ASSEMBLY
  44FK330      AUXILIARY PANEL ASSEMBLY
  44FK340      VOLTAGE REGULATOR
  44FK341       VOLTAGE REGULATOR CARD ASSEMBLY
  44FK342       VOLTAGE REGULATOR COMPONENT BOARD
  44FK350      BATTERY CHARGED
  44FK351       BATTERY CHARGER CARD ASSEMBLY
  44FK360      PROTECTIVE PACKAGE ASSEMBLY
  44FK361       OVERLOAD AND SHORT CIRCUIT CARD
  44FK362       OVER/UNDER FREQUENCY CARD
  44FK363       FREQUENCY METER CONVERTER CARD
  44FK364       OVER/UNDER VOLTAGE CARD
  44FK365       REVERSE CURRENT CARD
  44FK366       MECHANICAL FAULT MEMORY CARD
  44FK367       AUDIO ALARM/LOGIC/FLASHER CARD
  44FK368       STARTER OUTPUT AND OVERSPEED CARD
  44FK4       ENGINE GENERATOR BASE ASSEMBLY
  44FK5       FUEL ADAPTER DRUM ASSEMBLY
  44FK6       FUEL TANK
  44FK7       FUEL SYSTEM PLUMBING
  44FK8       HOUSING ASSEMBLY
  44FKA       PARALLEL CABLE ASSEMBLY
  44FKB       REMOTE CABLE ASSEMBLY
  44FKC       STORAGE BATTERY
  44FKD       TRANSFORMER AND LOAD BOARD ASSEMBLY
  44FKE       TRAILER ASSEMBLY
  ------      DIESEL ENGINE                (REF 46HA400)
  44FK9       NOC

44-14
```

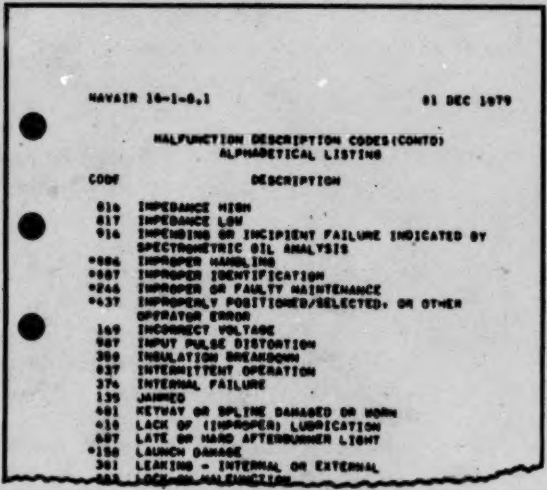
```
NAVAIR 16-1-8.1
                                            01 DEC 1979
                                ELECTRICAL GENERATION UNITS
    CODES

1 → 44FM0      MC8A MOBILE ELECTRIC POWER PLANT
    44FM1       ACCELERATOR ASSEMBLY
    44FM2       AC CABLE REEL ASSEMBLY
    44FM3       AC AND DC GENERATOR
    44FM4       BATTERY CABLE
    44FM5       BRAKE ASSEMBLY
    44FM6       CONTROL CABLE
    44FM7       COOLING ASSEMBLY
2 → 44FM800     CONTROL BOX ASSEMBLY
    44FM810      AC EXCITER
3 → 44FM820      AC VOLTAGE REGULATOR
4 → 44FM821       AC CIRCUIT BOARD ASSEMBLY
    44FM830      DC VOLTAGE REGULATOR
    44FM831       DC CIRCUIT BOARD ASSEMBLY
    44FM840      AC OVERVOLTAGE RELAY ASSEMBLY
    44FM850      AC UNDERVOLTAGE RELAY ASSEMBLY
    44FM860      OVERFREQUENCY RELAY ASSEMBLY
    44FM870      UNDERFREQUENCY RELAY ASSEMBLY
    44FM880      DC OVERVOLTAGE RELAY ASSEMBLY
    44FM890      INDICATOR FAULT BOARD
    44FM8A0      GOVERNOR CONTROL
    44FMA       ENGINE CONTROL PANEL
    44FMB       FUEL TANK
    44FMC       FRONT AXLE ASSEMBLY
    44FMD       GENERATOR PANEL
    44FME       HOOD ASSEMBLY
    44FMF       HOUSING COVER/DOOR/PANEL
    44FMG       PARKING BRAKE LEVER/LINKAGE
    44FMH       RUNNING GEAR ASSEMBLY
    44FMJ       REAR AXLE ASSEMBLY
    44FMK       STORAGE BATTERY
    44FML       SEAT SUPPORT ASSEMBLY
    44FMM       STEERING COLUMN ASSEMBLY
    44FMN       STEERING GEAR ASSEMBLY
    44FMP       SERVICE BRAKE ASSEMBLY
    44FMQ       TACHOMETER DRIVE CABLE
    44FMR       TRACTION MOTOR
    44FMS       WHEEL WELL ASSEMBLY
    44FMT       WHEEL ASSEMBLY
    44FMU       TIRES
    -----       DIESEL ENGINE                  (REF 46HA300)
    44FM9       NOC

    44FN0       9008700102 TRANSFORMER/RECTIFIER
    44FN9        NOC

    44FP0       PUT20/G ELECTRIC GENERATOR SET
    44FP100      REMOTE ASSEMBLY
    44FP110       FLASHER
    44FP200      CONTROL CUBICAL
    44FP210       LAMP AND SOLENOID DRIVER
    44FP220       OVER AND UNDER FREQ MONITOR
    44FP230       OVERSPEED MONITOR
    44FP240       OVERLOAD MONITOR
    44FP250       REVERSE POWER MONITOR
    44FP260       OVERVOLTAGE MONITOR
    44FP270       UNDERVOLTAGE MONITOR
    44FP271        LATCHING RELAY
    44FP280       CONTROL PANEL
    44FP290       VOLTAGE REGULATOR
    44FP2A0       BATTERY CHARGER

                                                  44-15
```

227.101

Figure 2-9.—Work unit codes.

figure 2-10 conditional codes are indicated by an asterisk (*) preceding the code. The malfunction description codes are listed in both alphabetical and numerical sequence in the Work Unit Code (WUC) manual.

When Discovered Code. This code consists of one alphabetic character which indicates when the need for maintenance action was discovered. Figure 2-11 is an example of some of these codes that are used.



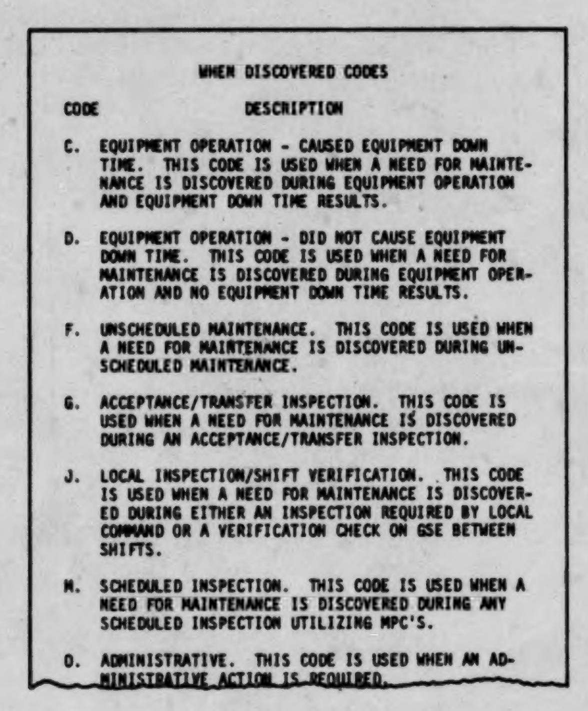
NAVAIR 16-1-0.1 01 DEC 1979

MALFUNCTION DESCRIPTION CODES(CONTD)
ALPHABETICAL LISTING

CODE	DESCRIPTION
816	IMPEDANCE HIGH
817	IMPEDANCE LOW
916	IMPENDING OR INCIPIENT FAILURE INDICATED BY SPECTROMETRIC OIL ANALYSIS
*806	IMPROPER HANDLING
*807	IMPROPER IDENTIFICATION
*246	IMPROPER OR FAULTY MAINTENANCE
*437	IMPROPERLY POSITIONED/SELECTED, OR OTHER OPERATOR ERROR
169	INCORRECT VOLTAGE
987	INPUT PULSE DISTORTION
309	INSULATION BREAKDOWN
037	INTERMITTENT OPERATION
374	INTERNAL FAILURE
135	JAMMED
481	KEYWAY OR SPLINE DAMAGED OR WORN
410	LACK OF (IMPROPER) LUBRICATION
687	LATE OR HARD AFTERBURNER LIGHT
*150	LAUNCH DAMAGE
381	LEAKING - INTERNAL OR EXTERNAL
	LOCK-ON MALFUNCTION

227.102

Figure 2-10.—Malfunction description codes.



WHEN DISCOVERED CODES

CODE	DESCRIPTION
C.	EQUIPMENT OPERATION - CAUSED EQUIPMENT DOWN TIME. THIS CODE IS USED WHEN A NEED FOR MAINTENANCE IS DISCOVERED DURING EQUIPMENT OPERATION AND EQUIPMENT DOWN TIME RESULTS.
D.	EQUIPMENT OPERATION - DID NOT CAUSE EQUIPMENT DOWN TIME. THIS CODE IS USED WHEN A NEED FOR MAINTENANCE IS DISCOVERED DURING EQUIPMENT OPERATION AND NO EQUIPMENT DOWN TIME RESULTS.
F.	UNSCHEDULED MAINTENANCE. THIS CODE IS USED WHEN A NEED FOR MAINTENANCE IS DISCOVERED DURING UNSCHEDULED MAINTENANCE.
G.	ACCEPTANCE/TRANSFER INSPECTION. THIS CODE IS USED WHEN A NEED FOR MAINTENANCE IS DISCOVERED DURING AN ACCEPTANCE/TRANSFER INSPECTION.
J.	LOCAL INSPECTION/SHIFT VERIFICATION. THIS CODE IS USED WHEN A NEED FOR MAINTENANCE IS DISCOVERED DURING EITHER AN INSPECTION REQUIRED BY LOCAL COMMAND OR A VERIFICATION CHECK ON GSE BETWEEN SHIFTS.
M.	SCHEDULED INSPECTION. THIS CODE IS USED WHEN A NEED FOR MAINTENANCE IS DISCOVERED DURING ANY SCHEDULED INSPECTION UTILIZING MPC'S.
O.	ADMINISTRATIVE. THIS CODE IS USED WHEN AN ADMINISTRATIVE ACTION IS REQUIRED.

227.103

Figure 2-11.—When discovered codes.

Action Taken Code. This code consists of one numeric or alphabetic character and indicates what maintenance action was taken on the item identified by the work unit code. Action taken codes 1 through 9 are only used when reporting repairable items of material which are found to be nonrepairable at the intermediate maintenance level. These codes are commonly referred to as BCM actions (Beyond Capability of Maintenance). These codes are:

CODE	DESCRIPTION
1	BCM - Repair not authorized
2	BCM - Lack of equipment, tools, or facilities
3	BCM - Lack of technical skills
4	BCM - Lack of parts
5	BCM - Fails check and test
6	BCM - Lack of technical data
7	BCM - Beyond authorized repair depth
8	BCM - Administrative
9	BCM - Condemned

The alphabetic action taken codes may be used for on or off equipment work. Some of the codes frequently used by the GSE technician are:

CODE	DESCRIPTION
A	No repair required
B	Repair and/or replacement of attaching units (seals, gaskets, packing, and electrical connections)
C	Repair (repaired a repairable item of material)
R	Removed and replaced material

Support Action Code. This code is a three-character numeric code used to identify routine, repetitive maintenance actions of a nonrepair type. These codes are used on Support Action Forms (SAFs) only, except in the case of 030 and 040 which can also be used on Visual Information Display System/Maintenance Action Forms (VIDS/MAFs) for scheduled inspections. Some of the frequently used support action codes are:

CODE	DESCRIPTION
010	Operational support, ground handling and servicing
020	Cleaning/Depreservation
030	Inspections (Calendar, Daily, Acceptance, etc.)
040	Corrosion prevention (This series of codes is further broken down into errosion prevention as) 041 Airframe enclosures 042 Power plants (engines) 044 Utilities (fuel-hydraulic systems, etc.) 045 Electronics/electrical (batteries, wiring, connections, etc.)
050	General functions (Wheel and tire buildup/teardown, painting, stenciling, etc.)
060	Buildup/teardown of engine and engine test stand operation
090	Non-aeronautical work. This includes the maintenance which cannot be properly charged to aircraft or support equipment maintenance.

The support action code 070 mission shop support is frequently misused by GSE shops. The 070 code is for handling of bombs, rockets, small arms, ammunition, etc.

Type Maintenance Code. This code consists of one alphabetic character and is used to describe the type of work being accomplished and is used on VIDS/MAF and SAF as indicated in description of these codes below. Type Maintenance Codes commonly used by GSE are:

CODE	DESCRIPTION
"A"	General Support—SAF only (Routine, repetitive type tasks that do not involve malfunctions, repair, or inspections)
"B"	Unscheduled Maintenance VIDS/MAF only except for the following: 1. Look phase of any inspection 2. Look and fix phase of GSE PM inspections 3. Calibration of precision measuring equipment 4. Transient maintenance
"C"	Preoperational inspections of GSE SAF only
"D"	Daily and postoperational inspections on GSE. Used on SAF special and special daily. This code is used on VIDS/MAF.
"E"	Acceptance/transfer inspection VIDS/MAF only.
"F"	Transient Maintenance—VIDS/MAF only. Maintenance or support actions performed on equipment in a transient status.
"P"	Preventive Maintenance (PM) inspections VIDS/MAF only. This code is used for PMs on GSE equipment.
"S"	Conditional inspection—VIDS/MAF only. The look and fix phase of conditional inspections on GSE will be assigned this code.
"U"	Reclamation and salvage—Used on SAF only. All work performed in connection with reclamation and salvage actions will be assigned this code.

Transaction Codes. These codes reflect the type of data being reported. The codes used most often by GSE personnel are:

CODE	DESCRIPTION
11	A. On-Equipment Work. Not involving removal of defective or suspected defective components/items. B. This code is also used at the organizational/intermediate level maintenance activities when closing out a maintenance action.
12	On-Equipment Work. Involving nonrepairable components/items, documented as failed parts.
31	Work performed on a removed repairable component/item with no failed parts or awaiting parts documented in the failed/required material blocks. This action is normally performed at the AIMD/IMA.
32	Work performed on a removed repairable component/item with failed parts, awaiting parts or cannibalization actions documented in the failed/required material blocks. This action normally performed at the AIMD.
39	Close out for man-hours or awaiting parts (AWP) at an intermediate level maintenance activity.
41	Technical directive compliance (TDC) with no part number change.
47	Technical directive compliance (TDC) with a part number change. This also applies to components/items that require blocks E and G information with no part number change.

Type Equipment Code. This code consists of four characters and is used to identify complete end item or category of equipment being worked on. A detailed listing of assigned codes are published in the Type Equipment Code Master List (NAMSO Report 4790.A7210.01).

Type equipment codes are structured in each code category. "A" series codes are aircraft codes. An example of code structuring used in this series is as follows:

Type Equipment Code AACG

AACG—A-4F Aircraft

A —Equipment Category (Aircraft)

AA —Aircraft Type (A-Attack)

AAC —Aircraft Type/Model (A-4)

AACG—Aircraft Type/Model/Series (A-4F)

Most of the time, as an AS, you will be using the "G" series type equipment codes. "G" series codes are Common Ground Support Equipment Codes. Some examples of these codes are as follows.

Type Equipment Code GACB

GACB—Sun Model NC-10 Diesel-driven mobile electric power plant

G —Equipment Category (common ground support equipment)

GA —Equipment Subcategory (electric generator units)

GAC —Equipment Group (diesel engine driven generator units)

GACB—Sun Model NC-10

Type Equipment Code GACG

GACG—NC-2A

G —Common ground support equipment

GA —Electric generator unit

GAC —Diesel engine driven electric generator units

GACG—NC-2A

The general equipment group is indicated by the code ending in "A" (GACA—diesel engine driven electric generator units). This code may be used when the specific equipment/model/series designation is not known, or when type equipment code is not assigned. It can also be used when work is performed on several different type/model/series equipment of the same general group. However, codes ending in"A" are not used where a more specific code applies.

Manufacturer's Code: A manufacturer's code is a five character numeric or alpha numeric code that identifies the manufacturer of a component, part, end item, etc. The handbooks H4-1 and H4-2 published by Defense Logistics Services Center gives all names and their codes.

Julian Date: The Julian date identifies the year and a numerical day of the year, and consists of four digits. The first digit indicates the year, and the remaining three characters specify the day of the year. For example, in the Julian date 0122 the first character (0) indicates the year (1980) and the last three characters specify the 122nd day of 1980 or 1 May 1980.

Job Control Number (JCN): The JCN is a 9-, 10-, or 11-character alpha numeric number that serves as a base for MDR and Maintenance Control procedures. The JCN allows for separate Control procedures. The JCN allows for separate identification of each maintenance action, and provides a link with the maintenance actions performed by the AIMD/IMA in support of an organization or an organizational discrepancy. The JCN is composed of four parts: (1) The organization code, (2) the day, (3) the serial number, and (4) the suffix.

(1) Organization Code: This is a three character alpha numeric code that identifies an organization. It is used in the JCN to identify the organization that originally assigned the JCN to a maintenance action.

(2) Day: Three numeric characters specify the day of the year. The Julian date of a JCN differs on the VIDS/MAF source document whereas the first position, identifying the year, is omitted. This is the date the JCN was assigned to a maintenance action and does not necessarily reflect the date on which work was actually started.

(3) Serial Number: The serial number is either a three character number that runs sequentially from 001 to 999, or a three character alpha numeric number with an alphabetic first letter and the last two characters running sequentially from 00 to 99, for example A01, A02, etc. (if more than 99, use alpha characters in the second and third positions, such as AA1, AA2, etc.). This number is normally assigned in sequence as new jobs are initiated (i.e., 001, 002, 003. . .). When the number 999 has been assigned, the next number in sequence will again be 001. Serial numbers with alphabetic first characters are used only when documenting major inspections other than preflight, postflight, turnaround, daily, special, conditional, corrosion, and acceptance/transfer inspections.

(4) Suffix: The JCN suffix is a structured alphabetic/numeric code added to the basic JCN as in above paragraphs to identify a subassembly or sub-subassembly repair action performed independently of the major component repair. The suffix is used for intermediate level maintenance functions only.

Bureau/Serial Number: A bureau/serial number is a number that identifies a specific end item/component. The number is usually assigned by the manufacturer or by the Navy and is used to differentiate between a particular end item/component and others of the same type, model, series, design, etc.

Work Center Code: Work center codes are three character codes that identify work centers. They are used in MDR to identify the work center performing the maintenance action documented. Work center codes for GSE are the 900 series and are listed in figure 2-12.

Maintenance Level: Each of the MDR source documents (SAF and VIDS/MAFs) has a data block labeled maintenance level. The MDR system is designed so that the level of the maintenance actually being performed is

900	Support Equipment Division
90A	Production Control
90B	GSE Pool
90C	GSE Training/License
910	Support Equipment Engine Repair Branch
91A	Air Start Repair
91B	Tow Tractor Repair
91C	Servicing Power Engine Repair
920	Support Equipment Structural/ Hydraulic Branch
92A	Structural Repair
92B	Hydraulic Repair
930	Support Equipment Electrical Repair Branch
93A	Electric Servicing Power
93B	Battery Shop
940	Support Equipment Component Repair Branch
950	GSE Inspection Branch
95A	Corrosion Control Shop
960	Installed Air Start Branch (Shipboard Only)
970	Air Conditioning Branch
980	GSE Flight Deck Troubleshooter Branch
990	Mobile Support Center Branch

Figure 2-12.—Work center codes for GSE shop.

indicated in this block. This information is not to be confused with the maintenance level assigned to the activity. For example, AIMD/IMA personnel may work on an aircraft performing on-equipment work. This job is indicated as organizational level maintenance. On-equipment work is considered as organizational level maintenance and off-equipment work is considered as intermediate level maintenance.

Items Processed: Items processed, for the purpose of MDR, is defined as the number of times that an action, indicated by an action taken code, is applied to the item identified by the WUC recorded on a VIDS/MAF, or the number of items completed by a support action. Example: Since the fuel nozzle of an engine is a coded item, replacement of five fuel nozzles would be documented as five items processed. In contrast, replacement of several transistors in an electronic assembly would be documented as one item processed, with the WUC identifying the electronic assembly being repaired and the action taken code indicating repair. For support actions, refueling five aircraft would be five items processed. VIDS/MAFs submitted for closeouts by all work centers at the end of, or during, a reporting period indicates 0 items processed. The items processed block is limited to two (2) characters. If the count exceeds 99 items processed, an additional form must be prepared and submitted.

Man-Hours: Entries in the man-hours block of the MDR forms represent all man-hours expended by assigned personnel to complete the work described on the source document. Hours and tenths worked, multiplied by the number of men working, equals total man-hours. The entry in the man-hours block of MDR forms does not include labor hours for any work center other than the one submitting the document. For example, if two work centers jointly correct a discrepancy (same JCN) on the same equipment, workers from each work center submit a source document with that particular work center's labor hours in the man-hours block.

Elapsed Maintenance Time (EMT): EMT for the purposes of MDR is defined as the actual clock time, in hours and tenths, that maintenance was being performed on a job. Although the EMT is directly related to job man-hours, it is not to be confused with total man-hours required to complete a job. For example, if five men complete a job in 2 hours of continuous work, the EMT = 2 hours times five men for a total of 10 man-hours (2 x 5 = 10) (EMT x men = man-hours).

VIDS/MAF

The Visual Information Display System/ Maintenance Action Form (VIDS/MAF) is provided in two-part and five-part formats. The two-part VIDS/MAF (OPNAV Form 4790/59) is used primarily by organizational level maintenance activities where the crowded condition of squadrons spaces and the need for fast procedures prohibit the use of the five-part form. The design of the form permits folding to fit the Visual Information Display System (VIDS) Board and serves as the Work Center Register. Both copies are identical and separated by carbon through to the second copy. This two-part form requires the use of the five-part form by Maintenance Control.

The five-part VIDS/MAF (OPNAV Form 4790/60) is used primarily by organizational and intermediate level maintenance activities as a Visual Information Maintenance Action Form. In addition to on-equipment maintenance actions, the form is used to document the removal and subsequent processing of a repairable component item to an AIMD. The first, third, fourth, and fifth copies of the five-part form contain the same information. Copy two is a tear-out of VIDS register size and contains the necessary data for material reporting. All copies are separated by carbon which permits coded information to carbon through to succeeding copies. At the intermediate level of maintenance, copy one of the five-part VIDS/MAF is used as the Work Center Register. The copy two is used as the Supply Department Register, copy three is the Production Control Register, copy four is the work center's Ready for Issue (RFI) or Beyond Capability of Maintenance (BCM) copy and copy five is the work center daily audit copy.

Figure 2-13 illustrates the documentation of a VIDS/MAF relating to the repair of a NR-1 air conditioner.

A step-by-step explanation of the entries is presented in the following paragraphs. It should be emphasized that this is only one example of many different actions that must be documented on a VIDS/MAF. For further information on VIDS/MAF, refer to OPNAVINST 4790.2 (Series). The following items refer to circled numbers on figure 2-13.

1. Entries Required Signature Block. This section is provided to ensure that historical records are updated in a timely and orderly manner. Maintenance control/logs and records personnel will screen all VIDS/MAFs and (x) appropriate blocks to indicate if log and/or SRC card entries are required. If entries are required, the name and rate of the person making the entries will be entered in the signature portion of the block to certify that the necessary entries have been made.

2. Reference/Local Use Block. Enter the supply reference in order to aid the Material Control Division in requisitioning the failed or required material. This block may also be used as desired locally.

3. Accumulated Work Hours Block.

a. Name/Shift—Enter the name and/or shift of personnel performing the work.

b. Date—Enter the Julian date on which the action takes place.

c. Man-hours—Enter the number of man-hours that were expended to correct the discrepancy (in hours and tenths).

4. Block A22 (Work Unit Code). Enter the WUC that identifies the system or component/part on which work is being done.

5. Block A29 (Action Organization). Enter the organization code of the organization accomplishing the work.

6. Block A32 Trans (Transaction Code). Enter the transaction code which describes the type of action accomplished on the document.

7. Block A34 Maint/L (Maintenance Level). Enter a number 1 through 3 that describes the level of maintenance being performed.

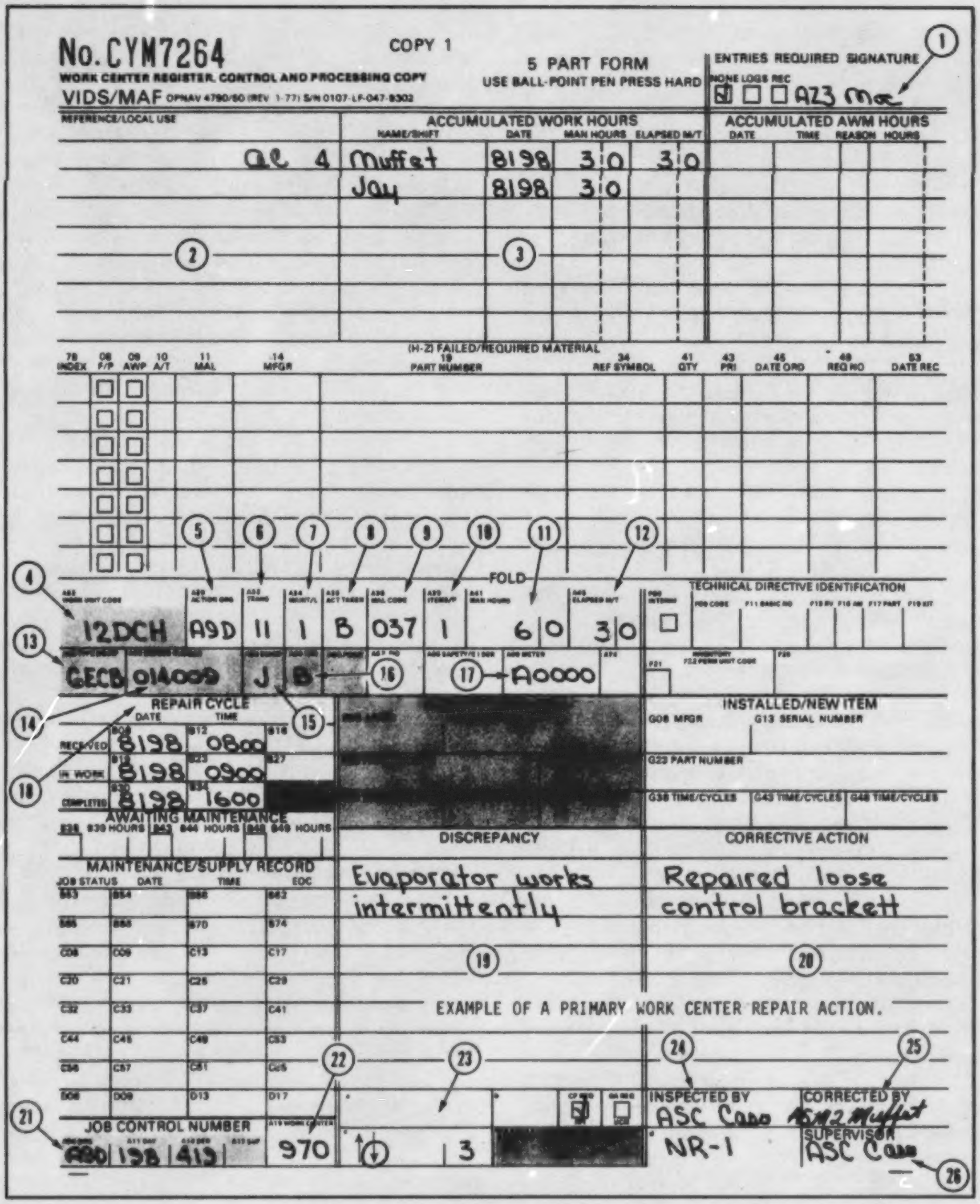
8. Block A35 Act Taken (Action Taken). Enter the code that describes the action taken to correct the discrepancy.

9. Block A36—MAL Code (Malfunction Description Code). Enter the malfunction description code that best describes the trouble or cause of trouble in the system or component identified in the Work Unit Code block (A22). When a conditional malfunction code is used on the primary document, the same code will be used on all related assisting VIDS/MAFs, suffix VIDS/MAFs, etc.

10. Block A39 Items/P (Items Processed). Enter the number of times the action indicated in block A35 (Action Taken) was taken against the item described in the work unit code block A22.

11. Block A41 (Man-Hours.) Enter the number of man-hours that were expended to correct the discrepancy (in hours and tenths).

12. Block A45 Elapsed M/T (Elapsed Maintenance Time). Enter the number of clock hours involved in making the repair (in hours and tenths). For example, if 3 people worked together for 2.5 hours to make a repair, the total man-hours (block A41) would be 7.5 hours



No. CYM7264
COPY 1
WORK CENTER REGISTER, CONTROL AND PROCESSING COPY
VIDS/MAF OPNAV 4790/60 (REV 1-77) S/N 0107-LF-047-9302
5 PART FORM
USE BALL-POINT PEN PRESS HARD

ENTRIES REQUIRED SIGNATURE
NONE ☑ LOGS ☐ REC ☐ AZ3 Moe

REFERENCE/LOCAL USE: AE 4

ACCUMULATED WORK HOURS

NAME/SHIFT	DATE	MAN HOURS	ELAPSED M/T
Muffet	8198	3.0	3.0
Jay	8198	3.0	

ACCUMULATED AWM HOURS: DATE TIME REASON HOURS

(H-Z) FAILED/REQUIRED MATERIAL: 78 INDEX, 08 F/P, 09 AWP, 10 A/T, 11 MAL, 14 MFGR, 19 PART NUMBER, 34 REF SYMBOL, 41 QTY, 43 PRI, 45 DATE ORD, 49 REQ NO, 53 DATE REC

FOLD

WORK UNIT CODE	ACTION ORG	TRANS	MALF/L	ACT TAKEN	MAL CODE	ITEMS/P	MAN HOURS	ELAPSED M/T
12DCH	A9D	11	1	B	037	1	6.0	3.0

TECHNICAL DIRECTIVE IDENTIFICATION: F08 CODE, F11 BASIC NO, F15 RV, F16 AM, F17 PART, F19 KIT

GECB | 014009 | J | B | A0000

INSTALLED/NEW ITEM: G08 MFGR, G13 SERIAL NUMBER, G23 PART NUMBER, G38 TIME/CYCLES, G43 TIME/CYCLES, G48 TIME/CYCLES

REPAIR CYCLE

	DATE	TIME
RECEIVED	8198	0800
IN WORK	8198	0900
COMPLETED	8198	1600

AWAITING MAINTENANCE: B38 B39 HOURS B43 B44 HOURS B48 B49 HOURS

MAINTENANCE/SUPPLY RECORD: JOB STATUS, DATE, TIME, EOC

DISCREPANCY
Evaporator works intermittently

CORRECTIVE ACTION
Repaired loose control brackett

EXAMPLE OF A PRIMARY WORK CENTER REPAIR ACTION.

JOB CONTROL NUMBER: A80 | 198 | 413
WORK CENTER: 970

3

INSPECTED BY: ASC Caso NR-1
CORRECTED BY: AMS2 Muffet
SUPERVISOR: ASC Caso

227.104

Figure 2-13.—Primary work center repair action.

40

(3 x 2.5) and the elapsed maintenance time would be 2.5 hours or the actual time it took to do the work.

13. Block A48 (Type Equipment Code). Enter the type equipment code that describes the end item on which work is being performed.

14. Block A52 (Bureau/Serial Number). Enter the bureau or serial number of the equipment or end item on which work is being performed.

15. Block A58—Discd (When Discovered Code). Enter the applicable When Discovered Code. When Discovered Codes are listed in Appendix V of OPNAV 4790.2.

16. Block A59—T/M (Type Maintenance Code). Enter the type maintenance code that describes the type of maintenance being performed.

17. Block A69—Meter. Enter the GSE meter reading.

18. Repair Cycle Blocks (Organizational).

a. Received Block:

(1) Block B08—Date. Enter the Julian date the discrepancy was reported.

(2) Block B12—Time. Enter the time the discrepancy was reported.

b. In Work Block:

(1) Block B19—Date. Enter the Julian date work was begun on the discrepancy.

(2) Block B23—Time. Enter the time work was begun on the discrepancy.

c. Completed Block:

(1) Block B30—Date. Enter the Julian date the repair action was completed.

(2) Block B34—Time. Enter the time the repair action was completed.

19. Discrepancy Block. Enter a narrative description of the reported discrepancy.

20. Corrective Action Block. Enter a narrative description of the action taken to correct the discrepancy.

21. Blocks A08 through A17. JCN (Job Control Number). Enter the assigned job control number. In the case of a maintenance action being performed on a transient aircraft (Navy or non-Navy), the first three positions of the JCN, block A08, are always the organization code of the aircraft reporting custodian.

22. Block A19 (Work Center). Enter the code of the work center performing the maintenance action described on the VIDS/MAF.

23. Blocks a, b, c, and d (Local Use). These are blank blocks for local use by the organizational and intermediate activities. Possible use of these blocks can include pool number, nomenclature, aircraft side number, work priority, supply project code, estimated completion time, crew size, etc.

24. Inspected By Block. The signature and rate of the quality assurance representative or collateral duty inspector who inspects the job for proper standards is entered in this block.

25. Corrected By Block. The signature and rate of the worker or crew leader who performs the maintenance action is entered in this block, and the VIDS/MAF is submitted to the work center supervisor.

26. Supervisor Block. The work center supervisor's or assistant supervisor's signature and rate are entered in this block to indicate that screening and other appropriate action has been performed. This person removes and retains the MDR verification copy, and forwards the original document to Maintenance Control.

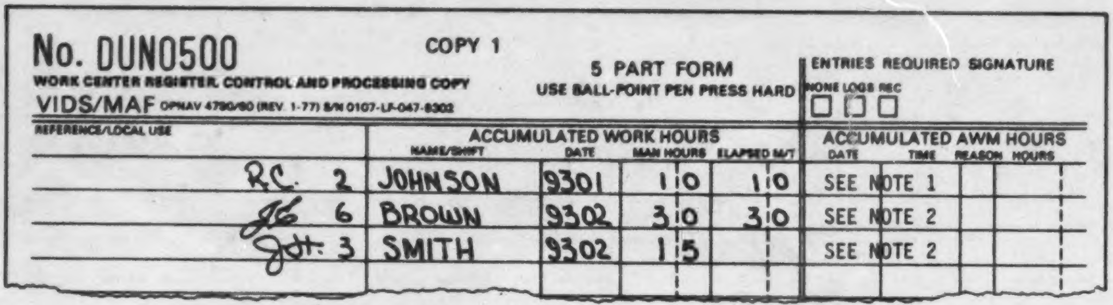
Maintenance Control screens all documents, enters appropriate date on logs and records, extracts essential data for ESD reporting, completes appropriate controlling blocks, and forwards the original document(s) to the Analysis Division.

The Reference/Local Use block can also be used for tool control, figure 2-14.

SUPPORT ACTION FORM (SAF)

The separate reporting of support data was designed so that the time expended in the performance of repetitive type tasks that consume many man-hours (but do not involve malfunction, repairs, or condemnation action) may be easily identified, reported, and monitored. Manhours expended in support duties such as aircraft refueling, engine or tire buildup, parachute packing, etc., will be documented on the Support Action Form (SAF), OPNAV Form 4790/42.

The SAF is a standard Electronic Accounting Machine (EAM) card that may be either handscribed or prepunched/preprinted, depending on the desires and requirements of local maintenance managers. In either case, all SAFs



No. DUN0500 COPY 1

WORK CENTER REGISTER, CONTROL AND PROCESSING COPY

VIDS/MAF OPNAV 4790/60 (REV. 1-77) S/N 0107-LF-047-8302

5 PART FORM

USE BALL-POINT PEN PRESS HARD

ENTRIES REQUIRED SIGNATURE

NONE ☐ LOGS ☐ REC ☐

REFERENCE/LOCAL USE	ACCUMULATED WORK HOURS				ACCUMULATED AWM HOURS			
	NAME/SHIFT	DATE	MAN HOURS	ELAPSED M/T	DATE	TIME	REASON	HOURS
R.C. 2	JOHNSON	9301	1 0	1 0	SEE NOTE 1			
[illegible] 6	BROWN	9302	3 0	3 0	SEE NOTE 2			
[illegible] 3	SMITH	9302	1 5		SEE NOTE 2			

NOTE 1: The workers having a tool container on the job will always have their names entered in the accumulated work hours block. Initials to the left of the tool container number indicate the Work Center Supervisor/CDI sight inventory after return of the container to the Work Center.

NOTE 2: Note the ease of annotating more than one tool container and certifying sight inventory whether or not the job is complete.

227.103

Figure 2-14.—Tool control.

are signed by the work center supervisor to indicate that screening has been completed.

To identify man-hours expended in specific categories of support work, three character codes known as support action codes are used. The non-basic categories of support type work and their codes are listed, together with type maintenance codes, on the back of the SAF as may be seen in figure 2-15.

SAF Documentation

SAFs are completed in the following manner:

1. Block 1 (Type Equipment Code). Enter the four-character code that identifies the equipment on which support work is being performed (i.e., aircraft, engines, GSE, etc.).

2. Block 2 (Action Organization). If not preprinted/prepunched, enter the three-character code that identifies the organization accomplishing the support action.

3. Block 2 (Work Center Code). If not preprinted/prepunched, enter the three-character code that identifies the work center performing the support action.

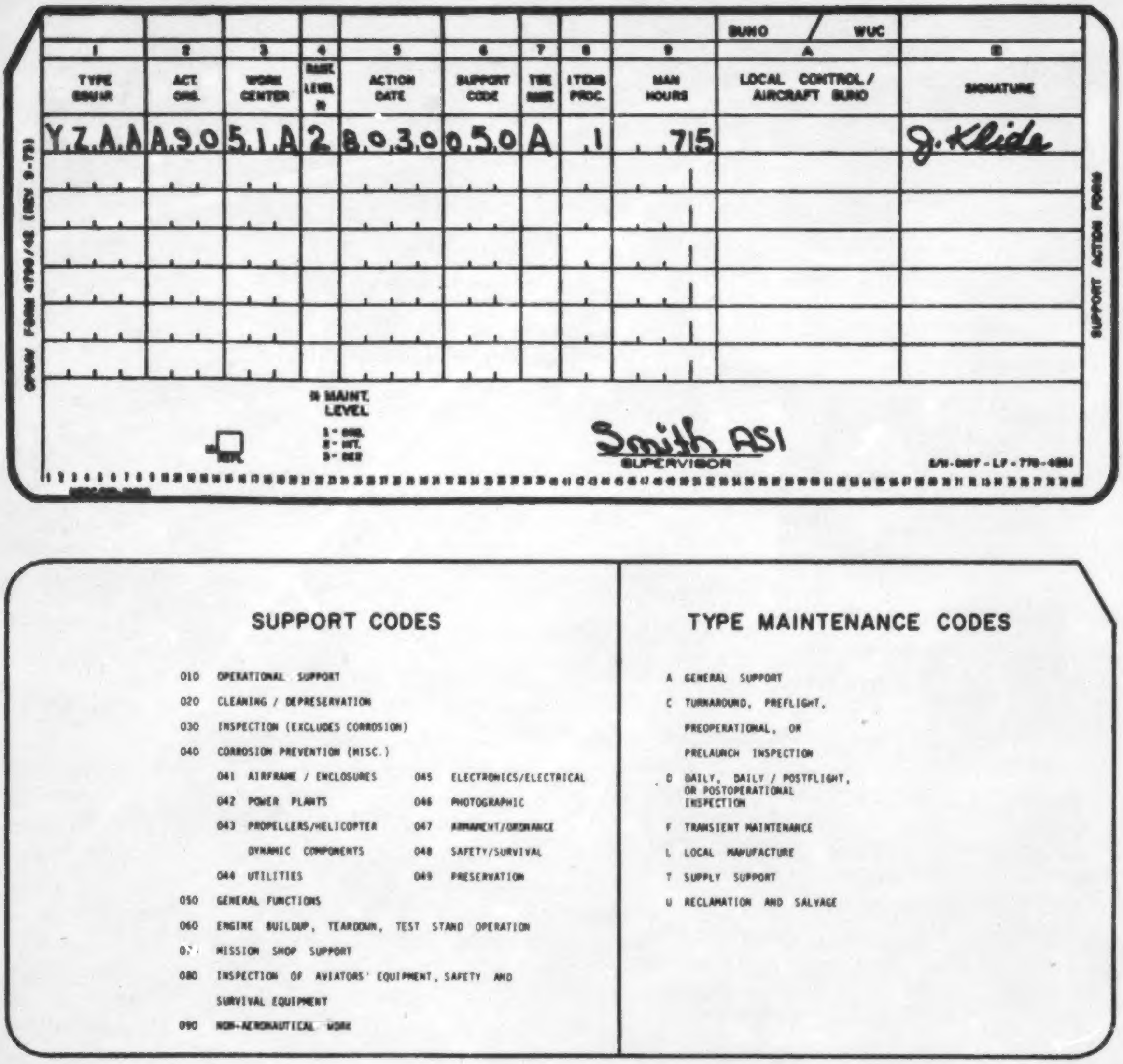
4. Block 4 (Maintenance Level). If not preprinted/prepunched, enter the one-character code that identifies the maintenance level of the support action being performed. (These codes are printed on the front of the SAF.)

5. Block 5 (Action Date). Enter the Julian date the support action was completed.

6. Block 6 (Support Code). Enter the three-character code that identifies the category of work in which the support action was performed. (These codes are listed on the back of the SAF.)

7. Block 7 (Type Maintenance Code). Enter the one-character code that identifies the type of support maintenance that was performed. (These codes are also listed on the back of the SAF.)

8. Block 8 (Items Processed). Enter the number of items processed, or the number of times that the support action identified in the Support Code block has been performed (i.e., four aircraft refueled, three preflight inspections



OPNAV FORM 4790/42 (REV 9-73)

SUPPORT ACTION FORM

									BUNO / WUC	
1	2	3	4	5	6	7	8	9	A	B
TYPE EQUIP.	ACT. ORG.	WORK CENTER	MAINT. LEVEL *	ACTION DATE	SUPPORT CODE	TYPE MAINT.	ITEMS PROC.	MAN HOURS	LOCAL CONTROL / AIRCRAFT BUNO	SIGNATURE
YZAA	A90	51A	2	8030	050	A	1	715		J. Klide

* MAINT. LEVEL
1 - ORG.
2 - INT.
3 - DEP.

Smith ASI
SUPERVISOR

S/N-0107-LF-770-4851

SUPPORT CODES

010 OPERATIONAL SUPPORT
020 CLEANING / DEPRESERVATION
030 INSPECTION (EXCLUDES CORROSION)
040 CORROSION PREVENTION (MISC.)
  041 AIRFRAME / ENCLOSURES
  042 POWER PLANTS
  043 PROPELLERS/HELICOPTER DYNAMIC COMPONENTS
  044 UTILITIES
  045 ELECTRONICS/ELECTRICAL
  046 PHOTOGRAPHIC
  047 ARMAMENT/ORDNANCE
  048 SAFETY/SURVIVAL
  049 PRESERVATION
050 GENERAL FUNCTIONS
060 ENGINE BUILDUP, TEARDOWN, TEST STAND OPERATION
070 MISSION SHOP SUPPORT
080 INSPECTION OF AVIATORS' EQUIPMENT, SAFETY AND SURVIVAL EQUIPMENT
090 NON-AERONAUTICAL WORK

TYPE MAINTENANCE CODES

A GENERAL SUPPORT
C TURNAROUND, PREFLIGHT, PREOPERATIONAL, OR PRELAUNCH INSPECTION
D DAILY, DAILY / POSTFLIGHT, OR POSTOPERATIONAL INSPECTION
F TRANSIENT MAINTENANCE
L LOCAL MANUFACTURE
T SUPPLY SUPPORT
U RECLAMATION AND SALVAGE

234.5

Figure 2-15.—Support Action Form (SAF) OPNAV Form 4790/42 (Rev. 9-73).

performed, etc.). Assisting work centers enter 0 items processed.

9. Block 9 (Man-hours). Enter the total number of man-hours (in hours and tenths) expended in the performance of the support action(s) documented on the same line of the SAF. A maximum of 999.9 man-hours may be reported on one line entry.

10. Block A (BUNO/Local Control Aircraft Bureau Number). This number will be entered in this block for all support actions involving corrosion control (where the Support Code is 040 through 049). In other cases, this block may be used at the discretion of the local activity to record bureau number or other data of interest.

11. Block B (Signature). Enter the signature of the person documenting the support action.

12. Block 10 (Replenishment). If prepunched/preprinted cards are authorized and desired, enter a checkmark in this block for replenishment. No other entry is authorized on a replenishment SAF. The maintenance officer controls and the Analysis Division coordinates the production, volume, and distribution of prepunched/preprinted cards.

CHAPTER 3

PUBLICATIONS

Technical manuals issued within the Naval establishment for aircraft ground support equipment and related systems operations and maintenance are published under the direction and authority of the Commander, Naval Air Systems Command. Their primary purpose is to aid technicians, like yourself, in accomplishing your assigned tasks.

Technical manuals concerned with flight personnel training and air operations are published by the authority of the Chief of Naval Operations and under the direction of the Commander, Naval Air Systems Command. Technical manuals and other data pertaining to naval aviation are managed and distributed by the Commanding Officer of Naval Air Technical Services Facility (NAVAIRTECHSERVFAC) Philadelphia, PA. They provide current authoritative information about material upkeep, checks, tests, repairs, and operation in order to provide optimum product performance. All personnel responsible for the operation and maintenance of ground support equipment must be thoroughly familiar with these publications and use the information and instructions in them when doing their jobs. Constantly changing modern technology demands continuous reference to, and use of, approved technical publications.

Publications issued by NAVAIR are known as aeronautic publications. They are divided into three categories and are issued in the forms of: (1) technical manuals, (2) technical directives, and (3) engineering drawings and associated data. Procedures in technical manuals are directive in type—that is, they are a "must." The information they contain is specific—NOT general in nature.

When a new item of equipment is accepted by the Navy, manual(s) necessary to ensure its proper operation and upkeep are prepared and made available to all activities using and/or maintaining the equipment. Supplemental information and directives that must be issued from time to time are published in the form of letter-type materials. Both manual- and letter-type publications usually are referred to as "directives." Broadly speaking, any communication which initiates or governs action, conduct, or procedures is a directive. Another term commonly used to identify manual- and letter-type publications is "technical data."

As emphasized throughout this module, all personnel of the AS rating must use applicable technical publications in the performance of their duties. This chapter will describe the type of information contained in technical publications used for the operation, servicing, and maintenance of support equipment.

NAVAL AERONAUTIC PUBLICATION INDEX

One of the requirements for advancement to ASM2 and ASE2 is to be able to use the different parts of the *Naval Aeronautic Publications Index* to locate and identify publications relative to the maintenance of support equipment.

The *Naval Aeronautic Publications Index* consists of several individual publications, each of which serves a specific purpose. The parts of the index are as follows:

Equipment Applicability List, NAVAIR 00-500A

Aircraft Application List, NAVAIR 00-500B

Directives Application List, NAVAIR 00-500C (Series)

Microfilm Cartridge Cross Reference, NAVAIR 00-500M (Series)

Support Equipment Cross Reference, NAVAIR 00-500SE

Navy Stock List of Forms and Publications. NAVSUP 2002

The content and purpose of each of these publications are discussed in the following paragraphs.

EQUIPMENT APPLICABILITY LIST, NAVAIR 00-500A

Basically, the *Equipment Applicability List*, NAVAIR 00-500A, commonly referred to as NAVAIR 00-500A, is a cross-reference index listing of NAVAIR manual-type publications according to model/type part number. It is issued annually and supplemented quarterly. At the time of this writing, the *NAVAIR 00-500A* consists of eight volumes. Each of the first seven volumes contains about 400 pages, and Volume 8 contains the remaining entries. With the exception of several small sections in the first part of Volume 1, the *NAVAIR 00-500A* is one continuous index of model/type part numbers listed in alphanumerical sequence.

In addition to an Introduction, the other sections in the first part of Volume 1 pertain primarily to manuals for aircraft, weapons systems, and aircraft engines. Therefore, the publications are listed according to their respective aircraft, aircraft engine, and weapons system designation. Of these sections the one titled Allowance Lists is the most important to the AS. Allowance lists are discussed in this chapter.

A complete list with explanations of all codes and statements used in the *NAVAIR 00-500A* is contained in the Introduction, located in the first part of Volume 1. This introduction also contains other valuable information concerning the use of the *NAVAIR 00-500A*. It is important that all users thoroughly study this section and become familiar with its contents. The format of the alphanumerical listing is illustrated in figure 3-1.

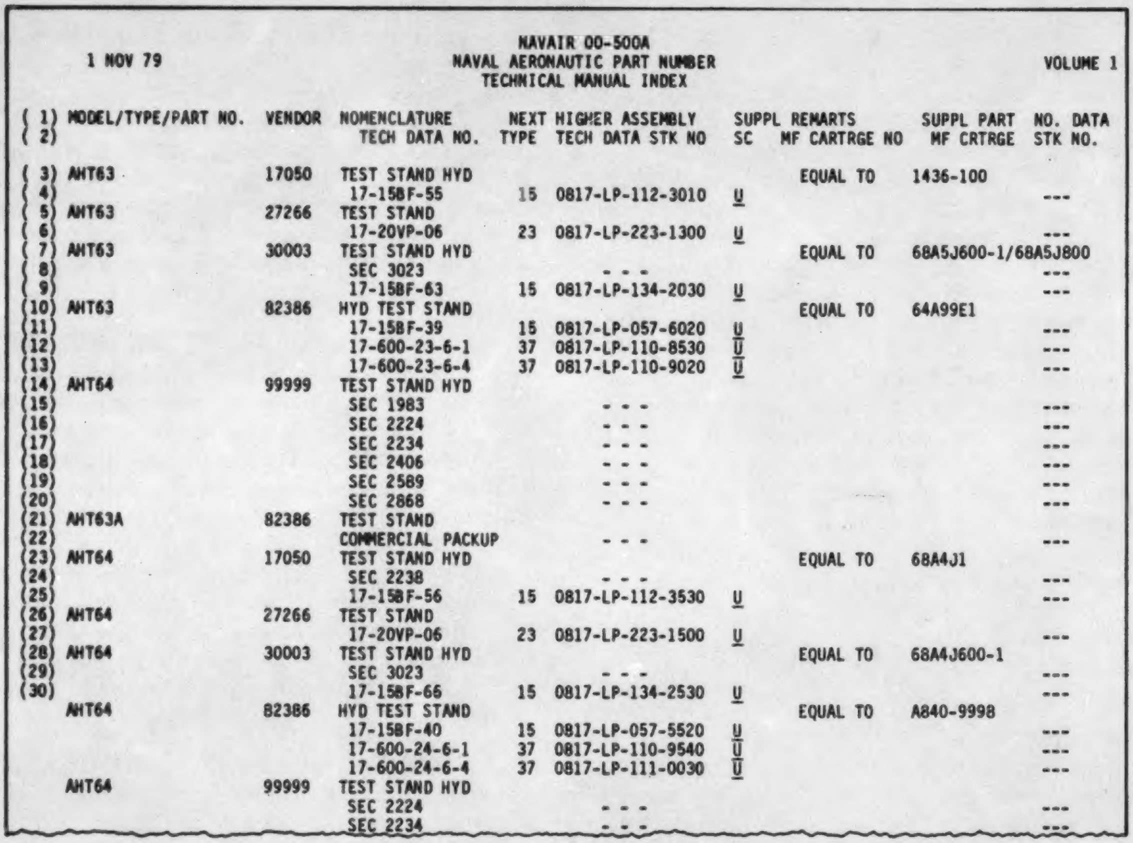
NOTE: It must be emphasized that figure 3-1 illustrates the format and use of the *Equipment Applicability List*, NAVAIR 00-500A. Although the information on the illustrated list was current at the time of this writing, all or any part of it is subject to change from time to time. Therefore, the latest edition and supplement (discussed later) of the *NAVAIR 00-500A* must be consulted in all actual cases.

Column Headings

The column headings of the page in the figure consist of two lines. (See lines (1) and (2) of figure 3-1.) Line (1) identifies what information about the specific item of equipment will be listed in the column below. The headings in line (2) indicate that the status of publications, or current publication number is listed on a line, or lines, under the information in the column under the heading.

MODEL/TYPE/PART NO—The identifying number of the specific item of equipment or system is listed in this column. Some items of equipment are identified by more than one part number. In these cases, all of the identifying numbers are listed in alphanumerical sequence. For example, the numbers listed in this column on lines (3), (5), (7), and (10) are different versions of the same model hydraulic test stand, AHT63. Each version is similar, but obtained from a different vendor.

VENDOR—The appropriate five-digit code which identifies the contractor or government agency that manufactured the item of equipment is listed in this column. If you need to interpret these codes, obtain Cataloging handbooks H4-1 and H4-2 from your technical library. If a vendor code is not firmly established at the time the item of equipment is listed, the code 99999 is inserted. Another use of the 99999 code as shown in line (14) indicates that SECs listed includes all AHT 63's.



```
                                        NAVAIR 00-500A
      1 NOV 79                    NAVAL AERONAUTIC PART NUMBER                                 VOLUME 1
                                     TECHNICAL MANUAL INDEX

( 1) MODEL/TYPE/PART NO.   VENDOR  NOMENCLATURE       NEXT HIGHER ASSEMBLY   SUPPL REMARTS       SUPPL PART   NO. DATA
( 2)                                 TECH DATA NO.    TYPE  TECH DATA STK NO  SC   MF CARTRGE NO  MF CRTRGE    STK NO.

( 3) AHT63                 17050   TEST STAND HYD                                  EQUAL TO     1436-100
( 4)                                 17-15BF-55        15  0817-LP-112-3010   U                                  ---
( 5) AHT63                 27266   TEST STAND
( 6)                                 17-20VP-06        23  0817-LP-223-1300   U                                  ---
( 7) AHT63                 30003   TEST STAND HYD                                  EQUAL TO     68A5J600-1/68A5J800
( 8)                                 SEC 3023                  - - -                                             ---
( 9)                                 17-15BF-63        15  0817-LP-134-2030   U                                  ---
(10) AHT63                 82386   HYD TEST STAND                                  EQUAL TO     64A99E1
(11)                                 17-15BF-39        15  0817-LP-057-6020   U                                  ---
(12)                                 17-600-23-6-1     37  0817-LP-110-8530   U                                  ---
(13)                                 17-600-23-6-4     37  0817-LP-110-9020   U                                  ---
(14) AHT64                 99999   TEST STAND HYD
(15)                                 SEC 1983                  - - -                                             ---
(16)                                 SEC 2224                  - - -                                             ---
(17)                                 SEC 2234                  - - -                                             ---
(18)                                 SEC 2406                  - - -                                             ---
(19)                                 SEC 2589                  - - -                                             ---
(20)                                 SEC 2868                  - - -                                             ---
(21) AHT63A                82386   TEST STAND
(22)                               COMMERCIAL PACKUP           - - -                                             ---
(23) AHT64                 17050   TEST STAND HYD                                  EQUAL TO     68A4J1
(24)                                 SEC 2238                  - - -                                             ---
(25)                                 17-15BF-56        15  0817-LP-112-3530   U                                  ---
(26) AHT64                 27266   TEST STAND
(27)                                 17-20VP-06        23  0817-LP-223-1500   U                                  ---
(28) AHT64                 30003   TEST STAND HYD                                  EQUAL TO     68A4J600-1
(29)                                 SEC 3023                  - - -                                             ---
(30)                                 17-15BF-66        15  0817-LP-134-2530   U                                  ---
     AHT64                 82386   HYD TEST STAND                                  EQUAL TO     A840-9998
                                     17-15BF-40        15  0817-LP-057-5520   U                                  ---
                                     17-600-24-6-1     37  0817-LP-110-9540   U                                  ---
                                     17-600-24-6-4     37  0817-LP-111-0030   U                                  ---
     AHT64                 99999   TEST STAND HYD
                                     SEC 2224                  - - -                                             ---
                                     SEC 2234                  - - -                                             ---
```

NOTE: THE SEQUENTIAL LINE NUMBERS, (1), (2), (3), ETC., IN THE LEFT MARGIN ARE FOR EXPLANATION PURPOSES ONLY.

225.5

Figure 3-1.—Alphanumerical listing.

NOMENCLATURE—A descriptive term for the item of equipment is listed in this column. For instance, the term "HYD TEST STAND" in figure 3-1 is typical of the descriptions used throughout the NAVAIR 00-500A.

NEXT HIGHER ASSEMBLY—In some cases, technical manuals are not required for a specific item of equipment because the necessary information is, or will be, included in the technical manual(s) for the next higher assembly. In these instances, the model/type part number of the next higher assembly is listed in this column.

SUPPLEMENTAL REMARKS (SUPPL REMARKS)—An entry is made in this column if the number listed under the MODEL/TYPE/PART NO., is being supplemented with other part number information. Listed below are the descriptions of the supplemental remarks:

DEFINITION	SUPPLEMENTAL REMARKS
Supersedes Completely	SUPS COMPL
Superseded Completely by	SUPSD COMPL BY
Interchangeable	INTERCHANGEABLE
Equal to	EQUAL TO
Superseded Partially by	SUPSD PARTLY BY
Superseded Partially	SUPS PARTLY

SUPPLEMENTAL PART NUMBER DATA (SUPPL PART NO DATA)—A part number listed in this column is associated with the statement listed in the SUPPL REMARKS column. Examples of this type entry are illustrated in line (7). As explained previously, this is a different number for the same hydraulic test stand. Although there are different numbers, only one is listed in each space. It should be noted, however, that regardless of which number of the Equipment Applicability List you look up first, you will be directed systematically through all part numbers. For example, assume that the only number you, as an AS, have available for this hydraulic test stand is Model NO. AHT-63. When you locate AHT-63 on the 10th line, you are referred to the part number, 64A99E1. This type of arrangement is used throughout the NAVAIR 00-500A when two or more numbers are listed for the same item of equipment.

TECHNICAL DATA NUMBER (TECH DATA NO)—To find the identifying number of the current technical manual and all proposed technical manuals (those which have been numbered but have not been published) look for it in the column under the descriptive name of the equipment. The numbering system (code numbers) for technical manuals is discussed later in this chapter. If the technical manual numbers have not been assigned, if it has not been determined if technical manuals will be procured, or if coverage will not be contained in a NAVAIR technical manual, a qualifying statement is entered in this column. For example: the statement "UNDER REVIEW" means that the part number was submitted to the Naval Air Technical Services Facility (NATSF) for possible action, but no decision was made prior to the date of the current issue of the NAVAIR 00-500A. The statement, "UNDER PROCUREMENT," indicates that publications are being procured for this item of equipment but the publication numbers have not be assigned. The Introduction in the first part of Volume 1 of the NAVAIR 00-500A has explanations of other qualifying statements used in this column.

TYPE—A code, for the type of technical manual, is listed on the second line in this column. For example, the number 05 is the code for Operation and Service Instructions Manuals, and the number 37 in line (11) is the code for Maintenance Requirements Cards for Ground Support. Since the use of these particular codes is limited to the *Equipment Applicability List,* NAVAIR 00-500A, a complete list of manual types and their corresponding codes is in the Introduction in Volume 1. Types of technical manuals for maintenance of support equipment are discussed later in this chapter.

TECHNICAL DATA STOCK NUMBER (TECH DATA STK NO)—The National Stock Number for ordering the publications is listed on the second line of this column. A stock number in this position indicates the technical manual is available and may be requistioned from the supply system by using the applicable stock number. Before ordering, look in the *Navy Stock List of Forms and Publications,* NAVSUP 2002 microfiche to obtain the complete publication title, date, and requisition restriction code. A blank space in this column indicates the technical manual was not available as of the date of the current NAVAIR 00-500A.

SECURITY CLASSIFICATION (SC)—Technical manuals listed are unclassified if the letter U is assigned. If the letter C (Confidential) or the letter S (Secret) is listed in this space, they are classified manuals.

MICROFILM CARTRIDGE NUMBER (MF CARTRGE NO)—A number in this position indicates if the publication is on microfilm. Here you will find the microfilm cartridge number assigned to the publication.

MICROFILM CARTRIDGE STOCK NUMBER (MF CARTRGE STK NO)—If there is a stock number listed in this column, the technical manual is available on microfilm. A cartridge number listed without a stock number is not available for issue. Such cartridges will be available in the near future. Publications on microfilm are discussed later.

AIRCRAFT APPLICATION LIST, NAVAIR 00-500B

The *Aircraft Application List,* NAVAIR 00-500B, is an annual publication which contains a listing of Naval Air Systems Command (NAVAIR) technical manuals grouped according to their application to a specific aircraft. Aircraft are arranged by model number and are grouped in series according to their mission (Attack Series, Cargo/Transport Series, Fighter Series, etc.). It also lists technical manuals dealing with electronics, armament, instruments, powerplants, etc. Technical manuals for each model aircraft are listed by code number. They are arranged by their subject matter in a numerical sequence of classification numbers shown in table 3-1. Groups 00 (Allowance List under the heading General), 17 (Machinery, Tool, and Test Equipment), and 19 (Ground Servicing and Automotive Equipment), are of most interest to the AS.

Table 3-1.—General subject classification numbers for manual-type publications

General	00
Aircraft	01
Powerplants	02
Accessories	03
Aircraft Hardware and Rubber Material	04
Instruments	05
Fuels, Lubricants, and Gases	06
Dopes and Paints	07
Electronics, Airfield Lighting and Related Accessories	08
Instructional Equipment and Training Aids	09
Photography	10
Aviation Armament	11
Parachute and Personal Survival Equipment	13
Standard Preservation and Packaging Instructions	15
Electronics	16
Machinery, Tools, and Test Equipment	17
Ground Servicing and Automotive Equipment	19
Instructional Equipment and Training Aids	28
Meteorology DCNO (AIR)	50
Ship Installations	51

The *Aircraft Application List,* NAVAIR 00-500B, is especially useful when you need to determine which manuals you need for equipment to support a particular model aircraft.

DIRECTIVE APPLICATION LIST, NAVAIR 00-500C (Series)

The NAVAIR 00-500C series are issued semiannually with no supplements and contain a listing of the published and distributed Naval Air Systems Command (NAVAIR) Technical Directives (letter-type) for each type of Navy aircraft. The publications are issued in sections (booklets) and each section is applicable to a specific aircraft series. The NAVAIR 00-500C.1 is for the A-3 aircraft, the NAVAIR 00-500C.2 is for the A-4 aircraft, etc. The custodians for each aircraft are automatically supplied with the applicable aircraft listing.

MICROFILM CARTRIDGE CROSS REFERENCE, NAVAIR 00-500M (Series)

The NAVAIR 00-500M (Series) index provides information on the contents, application and status of Maintenance Information Automated Retrieval System (MIARS) microfilm cartridges. MIARS microfilm cartridges contain technical manuals issued by Naval Air Systems Command. Parts I and II of this index make up NAVAIR 00-500M.1, which is issued quarterly with monthly cumulative supplements, Part III of the index makes up NAVAIR 00-500M.2, and is issued semiannually.

Part I is a cross-reference of NAVAIR technical manuals to a microfilm cartridge number. It also provides the latest issue date of the technical manuals and the date of the cartridge.

Part II is a listing of microfilm cartridges with the date of the latest cartridge.

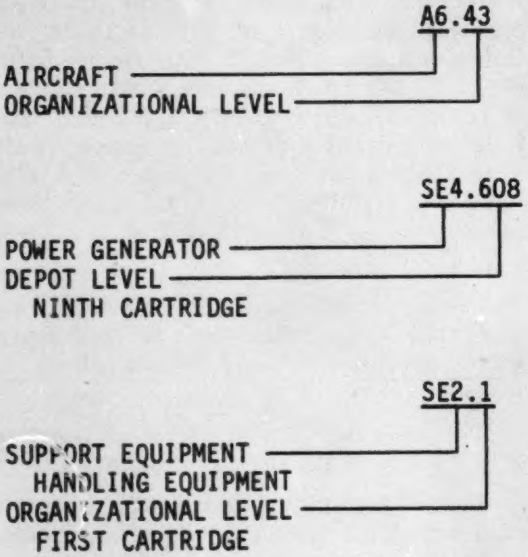
Part III lists microfilm cartridges along with their applicable technical manuals by aircraft model.

The cartridge numbering system for Support Equipment is different than that for aircraft and can be easily identified. Figure 3-2 compares examples of the two systems. The cartridges starting with SE and numbers 1 through 9 identify cartridges that contain technical manuals applicable to support equipment work unit codes. The cartridges SE1 for servicing equipment; SE2 for handling equipment; SE3 for test, check, calibrate, and inspection; and SE4 for power generation and supply are the ones that contain most of the Ground Support Equipment.

After the decimal point of the cartridge numbers there is a number from 1 through 899 which also identifies the level of maintenance the publication covers. Cartridges for the organizational level are 1 through 299, 300 through 599 apply to the intermediate level, and the cartridges for the depot level are 600 through 899. Notice from the example in the figure that the first cartridge for the depot level was 600, not 601.

SUPPORT EQUIPMENT CROSS REFERENCE, NAVAIR 00-500SE

This publication is a cross-reference for Support Equipment Changes. Currently effective Support Equipment Changes (SEC) are listed in NAVAIR 00-500SE in the two sections. Section 1 lists the SEC's in numerical sequence, along with the Type Equipment Code, and model/part number of the equipment that it is for. Section 2 is a cross-reference of Support Equipment Changes listed in alpha/numerical sequence by the model and part number of the equipment. Refer to figure 3-3. Note SEC 2896 is for an NC12A. You can use this reference list to find out what changes are in effect for your assigned equipment.



227.110

Figure 3-2.—Examples of GSE microfilm cartridge numbering system.

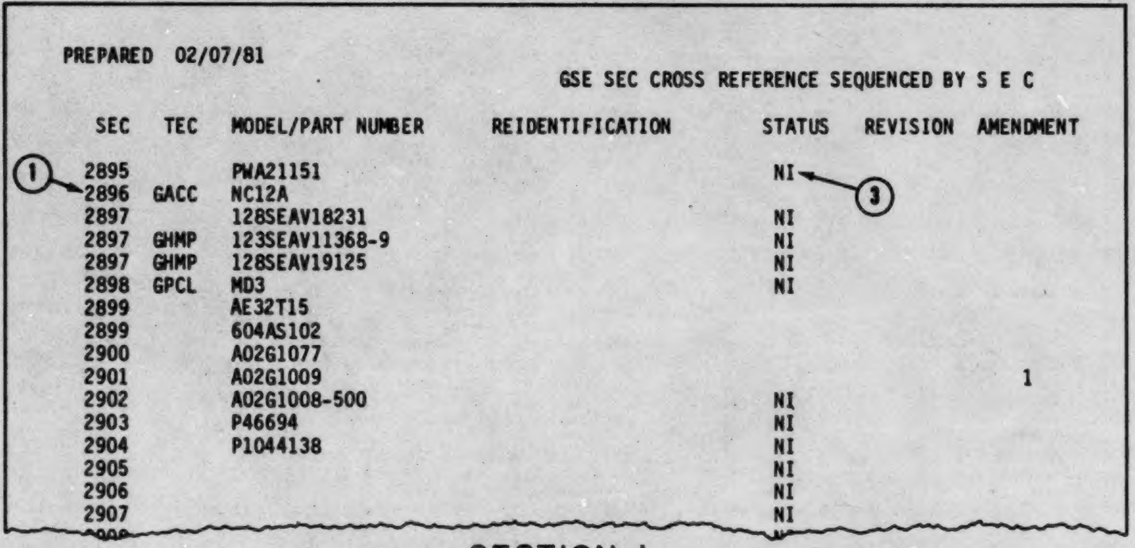
NOTE: NAVAIR 00-500SE Section 1 is by SEC number and Section 2 is by model/part number.

The status column (3) is blank, or has an NI or NA entered. A blank column indicates that the SEC is issued and active. NA in the column indicates that the SEC is cancelled or rescinded and NI indicates that the change has not been issued but will be issued in the near future.

Updating the Index Naval Aeronautic Publication Index

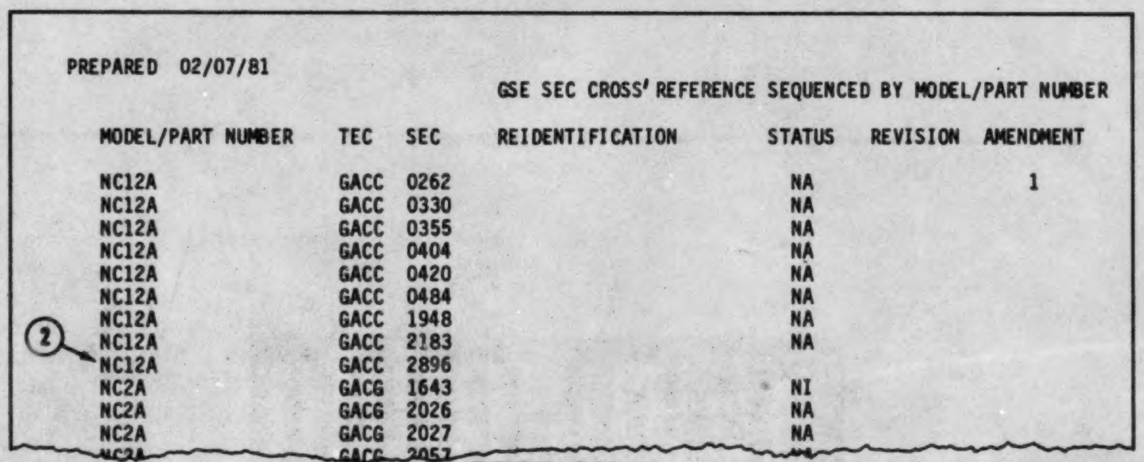
As indicated in the previous discussion, you use the different lists of the *Naval Aeronautic Publications Index* to locate and identify available technical publications applicable to the equipment you maintain. The Index has undergone many changes to improve its system of indexing technical publications. Therefore, when you receive new issues of the lists, check their introductory pages thoroughly for any changes that may have been incorporated.

The publications listed in the Index continually change. New equipment requires new publications. Old and obsolete equipment is retired and the applicable publications are cancelled. Changes to equipment require additional publications and/or changes and revisions to existing publications. Therefore, the *Naval Aeronautic Publications Index* must be constantly updated. To accomplish this, each list of the Index is replaced at regular intervals by a new list. In addition, some of the lists are kept current by the periodic issuance of supplements.



```
PREPARED  02/07/81
                                        GSE SEC CROSS REFERENCE SEQUENCED BY S E C

    SEC   TEC    MODEL/PART NUMBER      REIDENTIFICATION         STATUS   REVISION  AMENDMENT

    2895         PWA21151                                        NI
    2896  GACC   NC12A
    2897         128SEAV18231                                    NI
    2897  GHMP   123SEAV11368-9                                  NI
    2897  GHMP   128SEAV19125                                    NI
    2898  GPCL   MD3                                             NI
    2899         AE32T15
    2899         604AS102
    2900         A02G1077
    2901         A02G1009                                                             1
    2902         A02G1008-500                                    NI
    2903         P46694                                          NI
    2904         P1044138                                        NI
    2905                                                         NI
    2906                                                         NI
    2907                                                         NI
```

SECTION I



```
PREPARED  02/07/81
                                   GSE SEC CROSS REFERENCE SEQUENCED BY MODEL/PART NUMBER

    MODEL/PART NUMBER   TEC    SEC    REIDENTIFICATION        STATUS   REVISION  AMENDMENT

    NC12A               GACC   0262                             NA                   1
    NC12A               GACC   0330                             NA
    NC12A               GACC   0355                             NA
    NC12A               GACC   0404                             NA
    NC12A               GACC   0420                             NA
    NC12A               GACC   0484                             NA
    NC12A               GACC   1948                             NA
    NC12A               GACC   2183                             NA
    NC12A               GACC   2896
    NC2A                GACG   1643                             NI
    NC2A                GACG   2026                             NA
    NC2A                GACG   2027                             NA
```

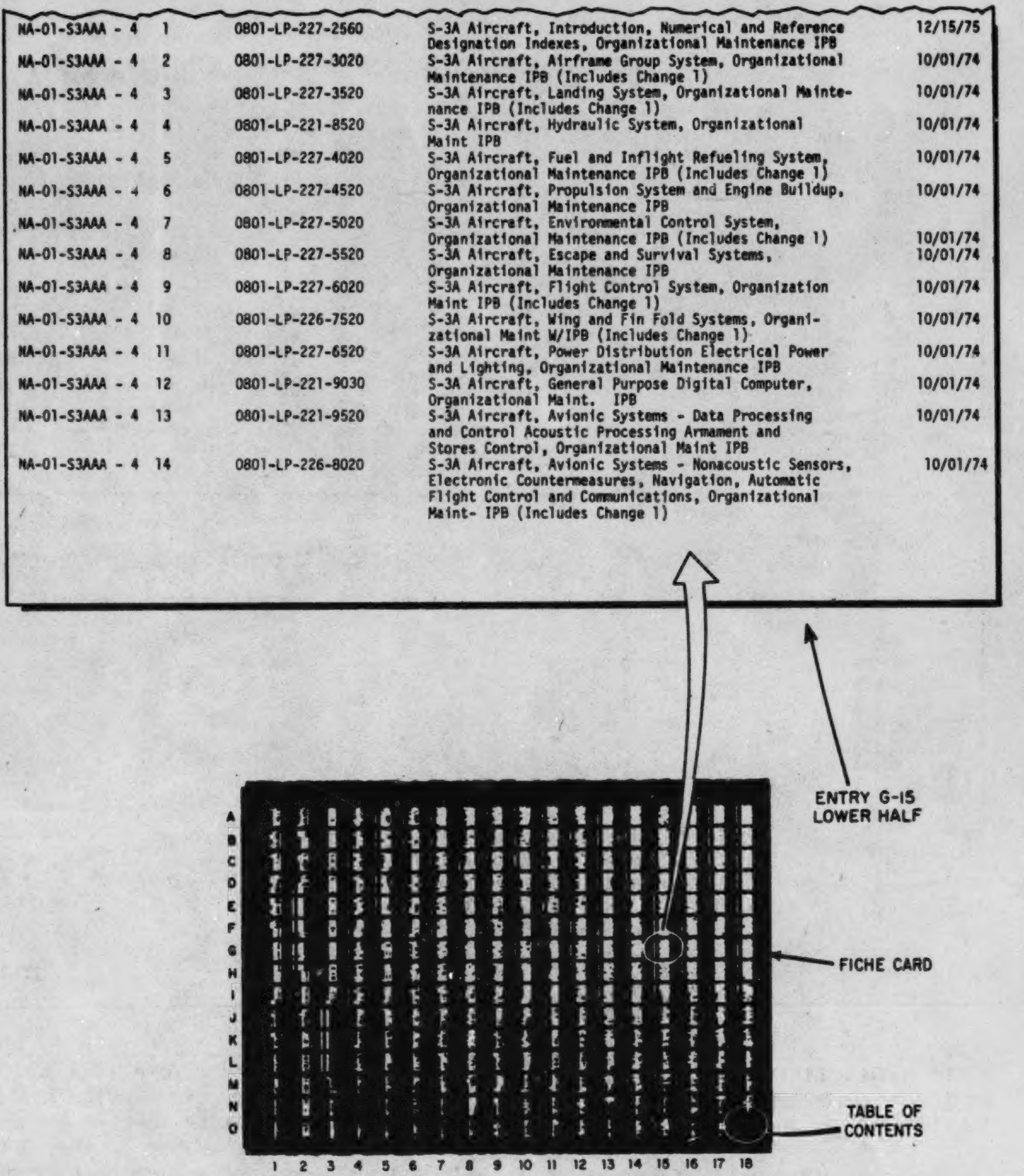
SECTION II

227.111

Figure 3-3.—NAVAIR 00-500E, Section I and II.

NAVY STOCK LIST OF PUBLICATIONS AND FORMS, NAVSUP 2002

The Navy Supply Systems Command maintains the inventory, and issues most of the publications used by the Navy. The catalog of these publications is the *Navy Stock List of Forms and Publications,* NAVSUP 2002. Most of your technical manuals may be found in NAVSUP 2002 if you know either their titles, their publication number, or their stock number. NAVSUP 2002 is principally used for ordering forms and publications from the supply system.



NA-01-S3AAA - 4	1	0801-LP-227-2560	S-3A Aircraft, Introduction, Numerical and Reference Designation Indexes, Organizational Maintenance IPB	12/15/75
NA-01-S3AAA - 4	2	0801-LP-227-3020	S-3A Aircraft, Airframe Group System, Organizational Maintenance IPB (Includes Change 1)	10/01/74
NA-01-S3AAA - 4	3	0801-LP-227-3520	S-3A Aircraft, Landing System, Organizational Maintenance IPB (Includes Change 1)	10/01/74
NA-01-S3AAA - 4	4	0801-LP-221-8520	S-3A Aircraft, Hydraulic System, Organizational Maint IPB	10/01/74
NA-01-S3AAA - 4	5	0801-LP-227-4020	S-3A Aircraft, Fuel and Inflight Refueling System, Organizational Maintenance IPB (Includes Change 1)	10/01/74
NA-01-S3AAA - 4	6	0801-LP-227-4520	S-3A Aircraft, Propulsion System and Engine Buildup, Organizational Maintenance IPB	10/01/74
NA-01-S3AAA - 4	7	0801-LP-227-5020	S-3A Aircraft, Environmental Control System, Organizational Maintenance IPB (Includes Change 1)	10/01/74
NA-01-S3AAA - 4	8	0801-LP-227-5520	S-3A Aircraft, Escape and Survival Systems, Organizational Maintenance IPB	10/01/74
NA-01-S3AAA - 4	9	0801-LP-227-6020	S-3A Aircraft, Flight Control System, Organization Maint IPB (Includes Change 1)	10/01/74
NA-01-S3AAA - 4	10	0801-LP-226-7520	S-3A Aircraft, Wing and Fin Fold Systems, Organizational Maint W/IPB (Includes Change 1)	10/01/74
NA-01-S3AAA - 4	11	0801-LP-227-6520	S-3A Aircraft, Power Distribution Electrical Power and Lighting, Organizational Maintenance IPB	10/01/74
NA-01-S3AAA - 4	12	0801-LP-221-9030	S-3A Aircraft, General Purpose Digital Computer, Organizational Maint. IPB	10/01/74
NA-01-S3AAA - 4	13	0801-LP-221-9520	S-3A Aircraft, Avionic Systems - Data Processing and Control Acoustic Processing Armament and Stores Control, Organizational Maint IPB	10/01/74
NA-01-S3AAA - 4	14	0801-LP-226-8020	S-3A Aircraft, Avionic Systems - Nonacoustic Sensors, Electronic Countermeasures, Navigation, Automatic Flight Control and Communications, Organizational Maint- IPB (Includes Change 1)	10/01/74

220.580

Figure 3-4.—Microfiche card example.

The *Navy Stock List of Publications and Forms,* NAVSUP 2002, has been converted to microfiche which is a film negative card (fiche). Figure 3-4 illustrates a fiche card used as part of a publications stock list deck. Throughout the Navy, fiche cards are used for many purposes where microfilming is used to reduce large amounts of paper documents. With this conversion the format of the publications is listed in an individual section. Each fiche card of this deck is approximately 5.75 by 4 inches which has a printed capacity of 270 printed pages of microfilmed data.

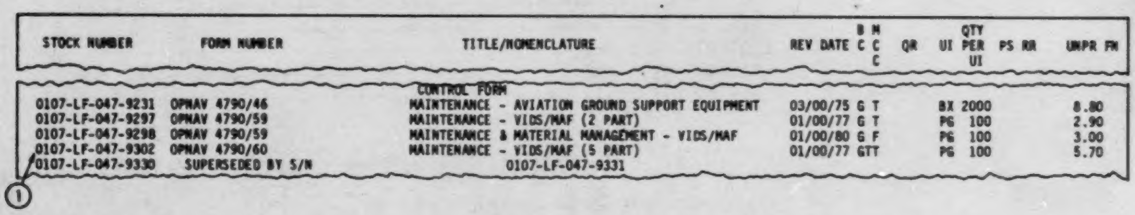
The particular fiche illustrated in this figure is divided into frame-grids of 15 rows (A through O down the side) and 18 columns (1 through 18 across). The lower right entry (0-18 or 18-0) is a table of contents for the fiche and lists the first entry of each frame-grid.

The NAVSUP 2002 has been changed from time to time. As of this writing, the NAVSUP 2002 has been modified to a three section microfiche publication as follows:

Section 1 is exclusively for forms, and is constructed in four segments identified as section 1A, 1B, 1C, and 1D. In section 1 you will find forms such as the VIDS/MAF (see note [1] in figure 3-5), which we will discuss later. Section 1A lists the forms by the form number, 1B by form title/nomenclature, 1C by form stock number, and 1D by a standard subject identification code.

Publications are found in Section 2 which has four segments: Section 2A shown in figure 3-6, and sections 2B, 2C, and 2D which are not shown. Section 2 is used in ordering maintenance and maintenance-related publications such as the publication for an NC 2A mobile electric power unit which is on the list in figure 3-3. Section 2A lists them by publication number, 2B by publication title/nomenclature, 2C by publication stock number, and 2D by electronic model number.

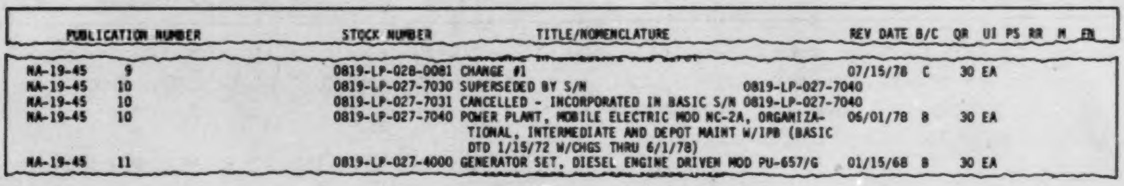
Section 3 pertains exclusively to NAVAIRSYSCOM Technical Directives. In the list on figure 3-7, find the manual: *Support Equipment Change* 3662 NC-8A, *Ether Start System Thermostat Assembly Replacemeht.* Refer to figure 3-8 for a column breakdown. Some of the headings are not used in all sections.



STOCK NUMBER	FORM NUMBER	TITLE/NOMENCLATURE	REV DATE	B C	M C C	QR	UI	QTY PER UI	PS	RR	UNPR	FN
		CONTROL FORM										
0107-LF-047-9231	OPNAV 4790/46	MAINTENANCE - AVIATION GROUND SUPPORT EQUIPMENT	03/00/75	G	T		BX	2000			8.80	
0107-LF-047-9297	OPNAV 4790/59	MAINTENANCE - VIDS/MAF (2 PART)	01/00/77	G	T		PG	100			2.90	
0107-LF-047-9298	OPNAV 4790/59	MAINTENANCE & MATERIAL MANAGEMENT - VIDS/MAF	01/00/80	G	F		PG	100			3.00	
0107-LF-047-9302	OPNAV 4790/60	MAINTENANCE - VIDS/MAF (5 PART)	01/00/77	G	TT		PG	100			5.70	
0107-LF-047-9330	SUPERSEDED BY S/N	0107-LF-047-9331										

227.106

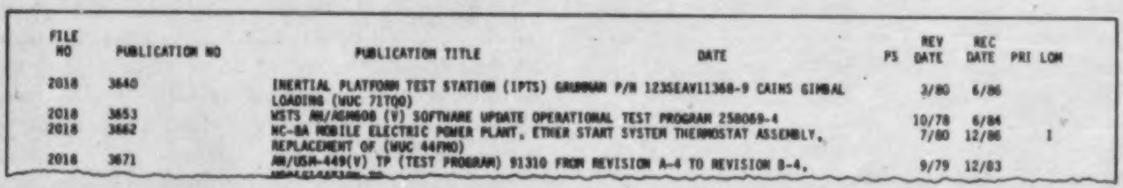
Figure 3-5.—NAVSUP 2002, Section 1C.



PUBLICATION NUMBER	STOCK NUMBER	TITLE/NOMENCLATURE	REV DATE	B/C	QR	UI	PS	RR	M	FN
NA-19-45 9	0819-LP-028-0081	CHANGE #1	07/15/78	C	30	EA				
NA-19-45 10	0819-LP-027-7030	SUPERSEDED BY S/N 0819-LP-027-7040								
NA-19-45 10	0819-LP-027-7031	CANCELLED - INCORPORATED IN BASIC S/N 0819-LP-027-7040								
NA-19-45 10	0819-LP-027-7040	POWER PLANT, MOBILE ELECTRIC MOD NC-2A, ORGANIZATIONAL, INTERMEDIATE AND DEPOT MAINT W/IPB (BASIC DTD 1/15/72 W/CHGS THRU 6/1/78)	06/01/78	B	30	EA				
NA-19-45 11	0819-LP-027-4000	GENERATOR SET, DIESEL ENGINE DRIVEN MOD PU-657/G	01/15/68	B	30	EA				

227.107

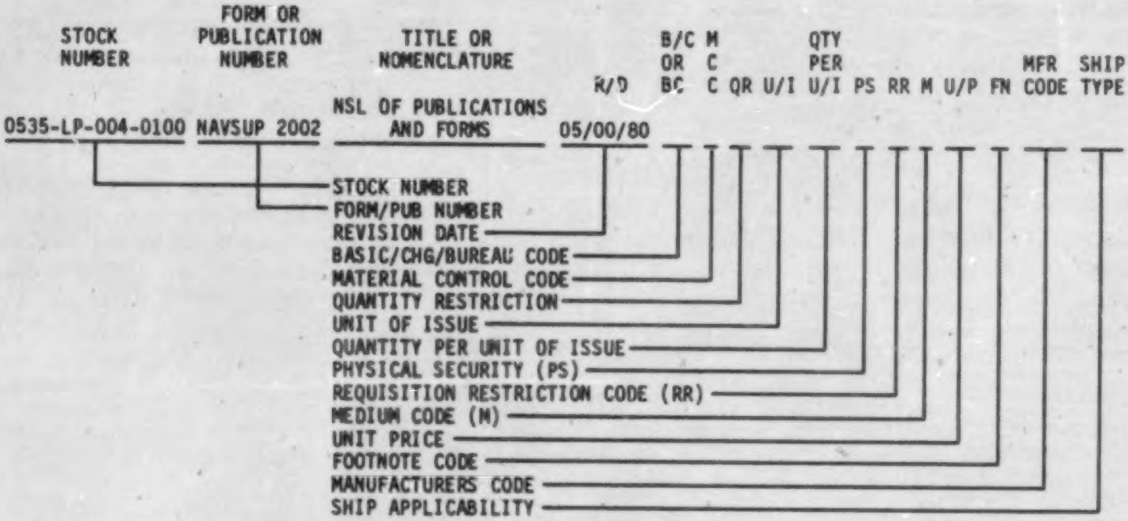
Figure 3-6.—NAVSUP 2002, Section 2A.



FILE NO	PUBLICATION NO	PUBLICATION TITLE	DATE	PS	REV DATE	REC DATE	PRI	LOM
2018	3640	INERTIAL PLATFORM TEST STATION (IPTS) GRUMMAN P/N 123SEAV11368-9 CAINS GIMBAL LOADING (WUC 71TQ0)			3/80	6/86		
2018	3653	WSTS AN/ASM608 (V) SOFTWARE UPDATE OPERATIONAL TEST PROGRAM 258069-4			10/78	6/84		
2018	3662	MC-8A MOBILE ELECTRIC POWER PLANT, ETHER START SYSTEM THERMOSTAT ASSEMBLY, REPLACEMENT OF (WUC 44FM0)			7/80	12/86		I
2018	3671	AN/USM-449(V) TP (TEST PROGRAM) 91310 FROM REVISION A-4 TO REVISION B-4,			9/79	12/83		

227.108

Figure 3-7.—NAVSUP 2002, Section 3.


STOCK NUMBER
FORM OR PUBLICATION NUMBER
TITLE OR NOMENCLATURE
R/D
B/C OR BC
M C C
QR
U/I
QTY PER U/I
PS
RR
M
U/P
FN
MFR CODE
SHIP TYPE
0535-LP-004-0100
NAVSUP 2002
NSL OF PUBLICATIONS AND FORMS
05/00/80
STOCK NUMBER
FORM/PUB NUMBER
REVISION DATE
BASIC/CHG/BUREAU CODE
MATERIAL CONTROL CODE
QUANTITY RESTRICTION
UNIT OF ISSUE
QUANTITY PER UNIT OF ISSUE
PHYSICAL SECURITY (PS)
REQUISITION RESTRICTION CODE (RR)
MEDIUM CODE (M)
UNIT PRICE
FOOTNOTE CODE
MANUFACTURERS CODE
SHIP APPLICABILITY

227.109

Figure 3-8.—Microfiche headings breakdown.

New microfiche editions of NAVSUP 2002 are issued quarterly in February, May, August, and November. Each edition reflects all current and available cognizance symbol I and II publications and forms. The NAVSUP 2002 includes an introduction microfiche. This introduction is reissued with each quarterly edition of the microfiche card deck. The introduction to the NAVSUP 2002 contains the following:

1. Instructions for ordering forms and publications.
2. Lists of prefixes and codes used to identify the various types of publications.
3. Standard abbreviations.
4. Identification aids and detailed instructions for requisitioning commercial books and publications sponsored by the other service branches and other U.S. Government departments.
5. Other detailed information pertaining to the requisitioning of printed material.

NAVAL AERONAUTIC PUBLICATIONS

PUBLICATIONS NUMBERING SYSTEM

Code numbers are assigned to all publications in order that they may be identified, indexed, and filed. A knowledge of the numbering systems enables the AS to locate any desired information with a minimum of time and effort. Here is a brief explanation of the coding of publications.

Manuals

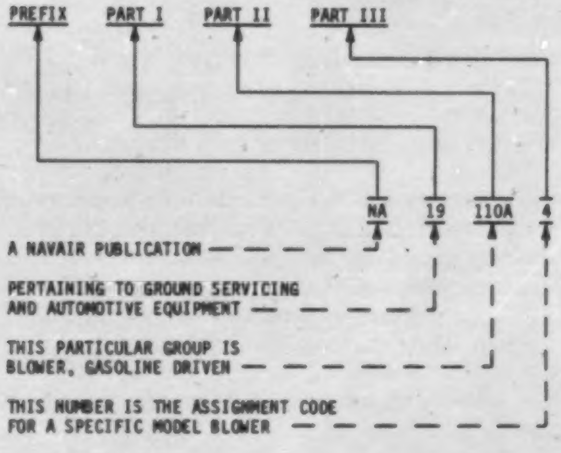
Figure 3-9 illustrates the identification and decoding of a complete manual publication number.

Code numbers assigned to manuals consist of a prefix and three groups of letters and/or numbers. Manual-type publications are listed in the Index with the prefix NA. This is the shortened form for NAVAIR and identifies those publications originated by the Naval Air Systems Command.

The three parts which make up the remaining portions of the number indicate the following:

Part I is a two-digit number that indicates general subject classification. Table 3-1 lists the general subject categories and the appropriate two-digit numbers.

Part II is a group of numbers or of numbers and letters which indicates the specific class, group, type, or model and manufacturer of the equipment. Table 3-2 shows the class identifying numbers for the 17- and 19- subject classifications.


PREFIX
PART I
PART II
PART III
NA
19
110A
4
A NAVAIR PUBLICATION
PERTAINING TO GROUND SERVICING AND AUTOMOTIVE EQUIPMENT
THIS PARTICULAR GROUP IS BLOWER, GASOLINE DRIVEN
THIS NUMBER IS THE ASSIGNMENT CODE FOR A SPECIFIC MODEL BLOWER

226.2

Figure 3-9.—Identification and decoding of manual publication code number.

Table 3-2.—Subject breakdown of series 17 and 19 manual-type publications

	17 Series—Machinery, Tools, and Test Equipment.
17-1	Shop and Warehouse Machinery, Tools and Test Equipment General.
17-5	Shop and Warehouse Machinery, Powered Tools and Equipment.
17-10	Shop and Warehouse Machinery, Powered Tools and Equipment.
17-15	Laboratory and Shop Test and Inspection Equipment.
17-20	Instrument Calibration Procedures.
17-25	Measurement System Operation Procedures.
17-35	Miscellaneous Calibration Publications.
17-40	MIARS Equipment
17-75	Testers and Test Card Sets
17-600	Ground Support Maintenance Requirement Cards.
	19 Series—Ground Servicing and Automotive Equipment.
19-1	General
19-5	Oxygen Equipment,
19-10	Airfield Lighting Equipment.
19-15	Platforms and Scaffolds.
19-20	Portable Shop Equipment.
19-25	Fire Trucks, Miscellaneous Trucks and Trailers.
19-30	Field Starters (Mobile).
19-35	Air Compressors (other than for Powerplants).
19-40	Tractors and Aircraft Towing.
19-45	Mobile Electric Power Plants.
19-50	Generators for Other Than Power Plants.
19-60	Portable Heaters and Coolers.
19-70	Aircraft Hydraulic Jacks
19-75	Generator Skid or Trailer Mounted (Gas/Nitrogen).
19-80	Motorized Material Handling Equipment.
19-95	Transportation and Loading Equipment Configuration.
19-100	Handling Equipment.
19-105	Gas Turbine Compressors and/or Power Units and Enclosures.
19-110A	Blower, Gasoline Driven.
19-600	Ground Support Maintenance Requirement Cards.

Part II is the number or numbers which designate a specific manual. For some manuals, this number designates a specific type of manual. However, for those pertaining to support equipment, this part is assigned in numerical sequence, and has no reference to the type of manual.

Letter-Type Directives

Letter-type directives include instructions, notices, and bulletins. Each directive has an identifying number. Two systems of numbering are used for the directives you will work with. The two systems of identifying directives are as follows:

1. According to specific application. This system uses a description of the application of the directive followed by a sequence number. For example, *Support Equipment Change* 590 is the 590th support equipment change that has been issued. All changes to support equipment are grouped together and numbered in sequence. Bulletins are numbered in the same way; however, those pertaining to specific items of auxiliary power servicing equipment are numbered in separate groups for each item of equipment.

2. According to subject matter code. This method is used for all Naval Air Systems Command Instructions and Notices. An example is NAVAIR Instruction 10304.1. The number 10340 indicates the general subject of the instruction, and the .1 indicates it is the first instruction issued by the Naval Air Systems Command on that particular subject. Table 3-3 shows the major classifications of the Navy Directives System. Notices carry the general subject number only, and do not carry a suffix. The current edition of a notice is identified by its date.

NOTE: Instructions and notices are NOT listed in the *Naval Aeronautic Publications Index*, but each activity that issues instructions publishes a notice numbered 5215 which lists its effective instructions.

Table 3-3.—Navy directives system subject classifications

1000 Series.	Military Personnel.
2000 Series.	Communications.
3000 Series.	Operations and Readiness.
4000 Series.	Logistics.
5000 Series.	General Administration and Management.
6000 Series.	Medicine and Surgery.
7000 Series.	Financial Management.
8000 Series.	Ordnance Material.
9000 Series.	Ships Design and Ships Material.
10000 Series.	General Material.
11000 Series.	Facilities and Activities Ashore.
12000 Series.	Civilian Personnel.
13000 Series.	Aeronautical and Astronautical Material.

SECURITY OF CLASSIFIED PUBLICATIONS

The *Department of the Navy Information Security Program Regulation,* OPNAV Instruction 5510.1 (Series), is issued by the Chief of Naval Operations. It is the basic security directive on the safeguarding of classified information. It applies to all military and civilian personnel and all activities of the Naval Establishment.

In this manual you will find detailed instructions for classifying, marking, and handling classified information, and for access to and authorized disclosure of the information.

You may never use classified publications, but if you do, before you accept such publications you must be cleared for access to the security level of the material in them. Whenever you have classified material, you must know and abide by the instructions in the *Security Manual.*

The security classification is prominently displayed on the cover and pages of each classified technical manual and is indicated in the Physical Security (PS) column of the NAVSUP 2002 stock number list. Sometimes not only the manual, but even its title is classified.

Unclassified manual titles are carried on the nomenclature, form/pub/hull and stock number microfiche cards. When the title of the manual is classified, nomenclature is omitted and the word "classified" is substituted for the actual title.

NOTE: Classifications appearing on the printed manuals, or NAVSUP 2002 listings, apply only to the information contained in the manual and not to the security classification of the equipment covered. Changes in classification of manuals are reflected as rapidly as possible after such action is approved.

PROCUREMENT OF PUBLICATIONS

You will obtain your technical publications by one of four ways.

The first method is initial outfitting. The Naval Air Technical Service Facility (NAVAIRTECHSERVFAC) automatically provides the commanding officer of a newly commissioned or reactivated ship, station, or activity an outfitting of general aeronautical publications.

A second method is used when support activities change their mission or aircraft, resulting in support equipment requirements changing. Such changes may require a different set of publications. Upon such a change, an Aeronautical Publications Outfitting Allowance for the model designations of the aircraft and equipment involved may be obtained by letter request from the commandnding officer of NAVAIRTECHSERVFAC.

The third source of publications is by automatic distribution from the Naval Air Technical Services Facility in Philadelphia. To automatically receive publications and changes your activity fills out *Automatic Distribution Requirements Tables*, NAVAIR 00-25DRT-1, and submits them to the Commanding Officer, NAVAIRTECHSERVFAC. As your needs change your activity will submit updated and revised tables. If you need to receive publications you are not getting, and particularly if you want to be sure of getting the latest changes and revisions, you must let your technical librarian know so that they can list your new requirements on their next submission of a NAVAIR 00-25DRT-1.

The fourth method of procuring publications is by ordering individual publications directly. Manual-type publications must be ordered on a Single Line Item Requisitioning System Document (DD Form 1348 or DD Form 1348m). Technical letter-type publications must be ordered on DD Form 1149. The use of any of these three forms will get you the publication, but will not result in being placed on the automatic distribution list.

MISCELLANEOUS AVIATION PUBLICATIONS

Several magazines containing articles of general interest to aviation personnel are published by authoritative sources in the Navy. These should be read regularly by all maintenance personnel.

Naval Aviation News

The Naval Aviation News, NAVAIR 00-75R-3, is published monthly by the Chief of Naval Operations and Naval Air Systems Command. It contains interesting and important articles on aviation training and operations, aviation support equipment, space technology, missile, rocket, and other aviation ordnance developments; aeronautical safety, aircraft design, powerplants, aircraft recognition, technical maintenance, and overhaul procedures.

This publication is essentially a news magazine. It enables readers to keep abreast of the latest unclassified developments in every facet of naval aviation. In addition, the coverage of fleet operations and the human interest articles on the noteworthy feats and accomplishments of individuals, both officer and enlisted, make *The Naval Aviation News* an entertaining as well as an informational magazine-type publication.

Maintenance Crossfeed

Maintenance Crossfeed publications are "Official Use Only" news letters issued by the

Naval Safety Center. Each Crossfeed is in the form of a monthly letter to aviation units.

Due to the designation "Official Use Only," *Maintenance Crossfeed* issues are not available for general distribution throughout an activity. *Maintenance Crossfeed* issues often contain material extracted from Accident Reports, Safety Reports, Quality/Deficiency Reports (QDR), Engineering Investigations (EI), Incident Reports, Ground Accident Reports, and Ground Incident Reports. Distribution of this type of information is limited to authorized persons, but the information is of importance to maintenance department personnel.

The unit's aviation safety officer generally passes on information from *Maintenance Crossfeed* to those with an obvious need to know and follows it up to see that it is used. However, each *Maintenance Crossfeed* may contain information that affects you. Keep in mind that on the average you will only see an occasional *Maintenance Crossfeed* unless you go out of your way to look for them. For those who need the information contained in *Maintenance Crossfeed* and are interested enough to ask for it, these publications can provide a wealth of useful and timely information.

Maintenance Crossfeed issues are printed in sections according to subject matter. The sections are listed as Maintenance Management, Airframes, Armament, Avionics, Ground Support, Powerplants, and Life Support Equipment. The pages of *Maintenance Crossfeed* issues are perforated to allow easy removal and retention of any one section by a work center without disturbing the other sections. Of course you are most concerned with the section titled Ground Support. The Maintenance Management section also has general information, and as the title reflects, it contains management material with which the more senior ASs should become familiar.

Mech

MECH is published quarterly by the Naval Safety Center and is distributed to naval aeronautical organizations on the basis of one copy for every ten persons. It presents the most accurate information available on maintenance-caused mishap prevention and general aviation ground safety. Its contents are informational and it should not be considered as a regulation, order, or directive.

MECH's motto is "Our product is safety, our process is education, and our profit is measured in the preservation of lives and equipment and increased mission readiness."

General Manuals (00 Series)

As indicated by the title, this series of manuals includes instructions and information of general interest to all naval aviation personnel. Included in these publications are the parts of the *Naval Aeronautical Publications Index* described previously (00-500A, 00-500B, 00-500C, and 00-500M, etc.) NAVAIR outfitting lists and allowance lists, and aviation training literature.

OUTFITTING LISTS AND ALLOWANCE LISTS, 00-35Q (Series).—Aircraft maintenance support and repair parts for aircraft maintenance repair are listed in NAVAIR's *Initial Outfitting Lists and Allowance Lists.* The equipment and parts listed in these publications are made available to aircraft operating and maintenance activities in accordance with assigned operational and maintenance responsibilities through appropriate applications of *Allowance Lists and Outfitting Lists.*

The Aeronautical Allowance Lists Program was designed to cover the various types of aircraft support equipment and repair parts considered to be required by maintenance activities.

Repair parts, nuts, bolts, etc., are included in the publications identified as *Initial Outfitting Lists.* Maintenance support equipment items such as test stands, aircraft jacks, lubricating guns, wrenches, drills, compass testers, and volmeters are included in publications identified as *Allowance Lists.* Most of these outfitting and allowance lists have been cancelled with no replacement.

A program closely related to the allowance lists and outfitting lists is the Aircraft Maintenance Material Readiness List (AMMRL) Program. This program provides for the development of data and documentation needed to determine and establish firm support equipment requirements and inventory control of aircraft maintenance support equipment. The AMMRL Program includes material readiness lists, which are discussed in the following paragraphs.

The *Application Data Material Readiness List* (ADMRL) specifies the requirements for each item of aircraft maintenance support equipment at each level of maintenance and for each aircraft, engine, propeller, and system. The initial ADMRL is established by NAVAIRSYSCOM.

The *Individual Material Readiness List* (IMRL) is derived from the more general ADMRL, and is designed for specific activities. Each list specifies items and quantities of ground support equipment required for material readiness of the aircraft maintenance activity to which the list applies. The list applies to an activity by name. The Naval Air Systems Command is responsible for the preparation of the IMRL for each activity in his cognizant area. It is prepared by extracting from the ADMRL those applicable portions which pertain to the specific aircraft and maintenance material assignments of the activity for which the list is developed.

The IMRL is reviewed annually and updated by each activity to support current and anticipated changes in ground support equipment requirements. Because the IMRL is continually reviewed and updated and approved by the cognizant command, it is the firm mandatory material readiness list of the activity to which the list applies.

TRAINING LITERATURE, 00-80 (Series).—This series of publications is issued by authority of the Deputy Chief of Naval Operations (Air). The series includes various air safety pamphlets and general aviation training manuals. For example, NA 00-80T-96, *Aircraft Support Equipment, General Handling and Safety Manual,* is one of the training manuals in this series.

Support Equipment Manuals (17 and 19 Series)

The 17 and 19 series of aeronautical technical manuals cover most types of support equipment. The manufacturer of each item of support equipment is required to furnish adequate instructions for operating the equipment and maintaining it throughout its service life. The manufacturer does this by preparing a support equipment manual which is approved by and issued under the authority of the Naval Air Systems Command. These support equipment manuals are official Navy publications.

Support equipment manuals contain descriptive data, detailed instructions for operation, servicing, inspection, maintenance, repair, and overhaul, and illustrated parts lists.

If an item of support equipment is relatively simple, all the necessary instructions may be contained in a single manual. An example is NA 19-1-60, *Operations, Service, and Overhaul Instructions with Illustrated Parts Breakdown for the Aircraft Universal Towbar Assembly.* More complex equipment may require two or more manuals. For example, one manual may contain operation, service, and repair instructions, while the parts breakdown is contained in a separate manual.

Regardless of the number of manuals used to contain these instructions, the terms "Operation," "Service," and "Repair" or "Overhaul" are usually used in the title of these instructions. However, some of the newer models of equipment are provided with manuals for different levels of maintenance. In this case, the manuals are titled "Maintenance Instructions, Organizational Level"; "Maintenance Instructions, Intermediate Level"; and, if required, "Maintenance Instructions, Depot Level."

OPERATION AND SERVICE INSTRUCTIONS.—Although sometimes issued as separate manuals, operations and service instructions for each item of support equipment are usually combined into one manual, and, as previously stated, are often combined with other instructions and the parts breakdown. Operations and service instructions include information necessary for organizational level maintenance (the first level of maintenance). Operation and service instructions manuals are divided into sections, but they vary as to content and number of sections. The following is a description of a typical manual:

The first section is an introduction and description of the equipment. This section also contains a table of specifications. These specifications include the weight and overall dimensions of the equipment; capacities of the fuel, oil, and cooling systems; the manufacturer, model and type; and leading particulars of the engine, fuel system components, electrical systems components, transmissions, and other major components.

The second section of a typical manual is a list of special tools required for the operation and service of the equipment.

The third section gives information for preparing the unit for use. Instructions for unpacking and assembling the unit are covered in this section. The third section also includes any adjustments and inspections that must be made and any safety precautions that must be observed before the unit is operated. (Some manufacturers also include in this section information about preparing the unit for storage and shipment.)

The fourth section has complete and detailed operating procedures for the equipment. Such information as the principles of operation, the purpose and use of the operation controls, and the purpose and use of the indicating instruments are included in this section. Normal operating pressures and temperatures are also given. Safety precautions under the headings of "WARNINGS" and "CAUTIONS" are inserted in the appropriate parts of the text. The same methods of emphasizing and calling your attention to safety precautions are used in all support equipment instructions and manuals.

The service instructions are contained in the fifth section. These instructions tell you how to perform periodic inspections, maintenance, and lubrication. Charts or tables are there to indicate the inspection interval of systems and components. (Periodic inspections of most support equipment are performed in accordance with Maintenance Requirement Cards which are used in conjunction with the information contained in this section.) You will find the specifications for oil, fuel, lubricants, etc., in this section. Diagrams, showing the places to be lubricated, are also included. (In some manuals, troubleshooting charts are also in this section. Other manuals contain an additional section for these charts.)

The Operation and service instructions, as well as the other parts of support equipment manuals, use pictures to clarify the text. The illustrations used in support equipment manuals are similar to those in this training manual; both use a wide variety of graphic presentations. Included are pictorial drawings (isometric drawings and reproductions of photographs), orthographic drawings, and schematic and block diagrams. Sometimes you will see combinations of these drawings and diagrams being used.

NOTE: For detailed information concerning different types of drawings and diagrams, including the definitions of terms used in conjunction with these graphic presentations, refer to *Blueprint Reading and Sketching,* NAVPERS 10077 (Series) which also illustrates many of the different symbols used on diagrams.

REPAIR OR OVERHAUL INSTRUCTIONS.—Two types of manuals are used for intermediate level maintenance of support equipment. They are "Repair Instructions" and "Overhaul Instructions." Some manuals cover both the repair and the overhaul operations, and are called "Maintenance Instructions."

Repair instructions describe how to restore defective equipment to acceptable operation without complete disassembly and inspection. Overhaul instructions tell you how to disassemble a piece of equipment and inspect every component, to replace parts or restore them as needed, and reassemble and test the equipment to ensure its being up to design specifications.

If the Repair or Overhaul Instructions are published in separate manuals, the first section of each is a brief introduction. This includes the purpose and leading particulars of the item of equipment. The remainder of the manual contains complete repair or overhaul instructions and test procedures. Some manuals combine the Operation and Service Instruction with the Repair or Overhaul Instruction, which are arranged in a section, or sections, following the service instructions.

ILLUSTRATED PARTS BREAKDOWN.—The Illustrated Parts Breakdown (IPB) is very helpful in the identifying, requisitioning, and issuing of parts for support equipment.

The IPB for a complex item of support equipment is issued as a separate manual and has its own identification number. The IPBs for most support equipment are combined with one or more sections of the instructions manuals and are the last section or sections of the manual. An example of the title of a combined manual is "Operation and Service Instructions with Illustrated Parts Breakdown."

Although the IPB appears in some manuals as one section, it is usually divided into three sections or parts—Introduction, Group Assembly Parts List, and Numerical Index. In addition to these three parts, it has a Table of Contents. If the IPB is a separate manual, the Table of Contents is contained in the first few pages of the manual. If the IPB is combined with instructions manuals, a combined Table of Contents appears in the first few pages of the combined manual. In either case, the Table of Contents contains a List of Illustrations which plays an important role in locating parts in the IPB.

The Introduction tells how to use the IPB. You should read this section carefully before using the remaining sections. The Introduction will help you locate the necessary information about a part or parts quickly and easily.

The next section, Group Assembly Parts List, lists and illustrates the assemblies and parts of the equipment. As mentioned previously, exploded views are usually used to illustrate these assemblies and parts. The parts lists are used in conjunction with the illustrations. Index numbers in the parts lists correspond to those in the illustrations. You use this section and the List of illustrations to locate and identify a part when the part number is unknown. This process is shown in figure 3-10.

The last section, the Numerical Index, contains an alphanumerical listing of all the parts in the IPB. In addition to the part numbers, the Numerical Index contains such information as national stock number data, figure and index numbers, source code data, and repair code.

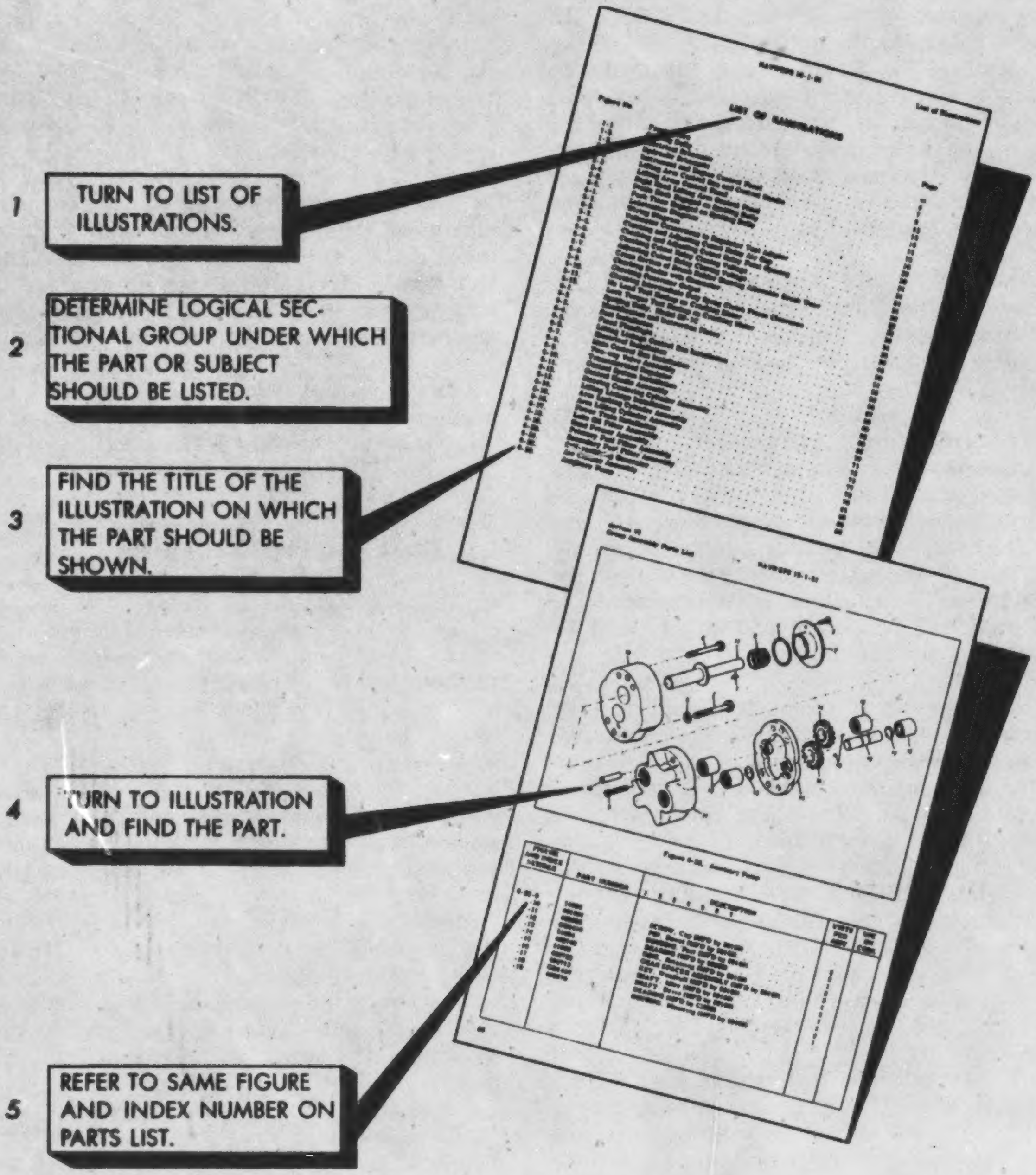
The Numerical Index is used to find the illustration and nomenclature of a part if the part number is known. Figure 3-11 shows how to do this.

GSE GENERAL PUBLICATIONS

You as an AS, should become familiar with some NAVAIR publications that cover general technologies and procedures. The following paragraphs will describe some of these which will be valuable to you.

The Aviation Hydraulic Manual, NAVAIR 01-1A-17, is applicable to all aircraft hydraulic systems and related hydraulic servicing and test equipment. This includes all GSE that is used or could be used with aircraft, such as the AHT-64 Hydraulic Test Stand and the H-250-1 Hydraulic Servicing Unit. *The Aviation Hydraulics Manual* is required reading for all personnel (military and civilian) at all maintenance levels who perform any hydraulic maintenance function on naval aircraft systems and related ground support equipment (GSE).

The publication, *Inspection and Proofload Testing of Lifting Slings and Restraining Devices for Aircraft and Related Components,* NAVAIR 17-1-114, can be very helpful to you in identifying aircraft slings. It also contains information on the repair and testing of the TD-1A tiedown chain.



1 TURN TO LIST OF ILLUSTRATIONS.

2 DETERMINE LOGICAL SECTIONAL GROUP UNDER WHICH THE PART OR SUBJECT SHOULD BE LISTED.

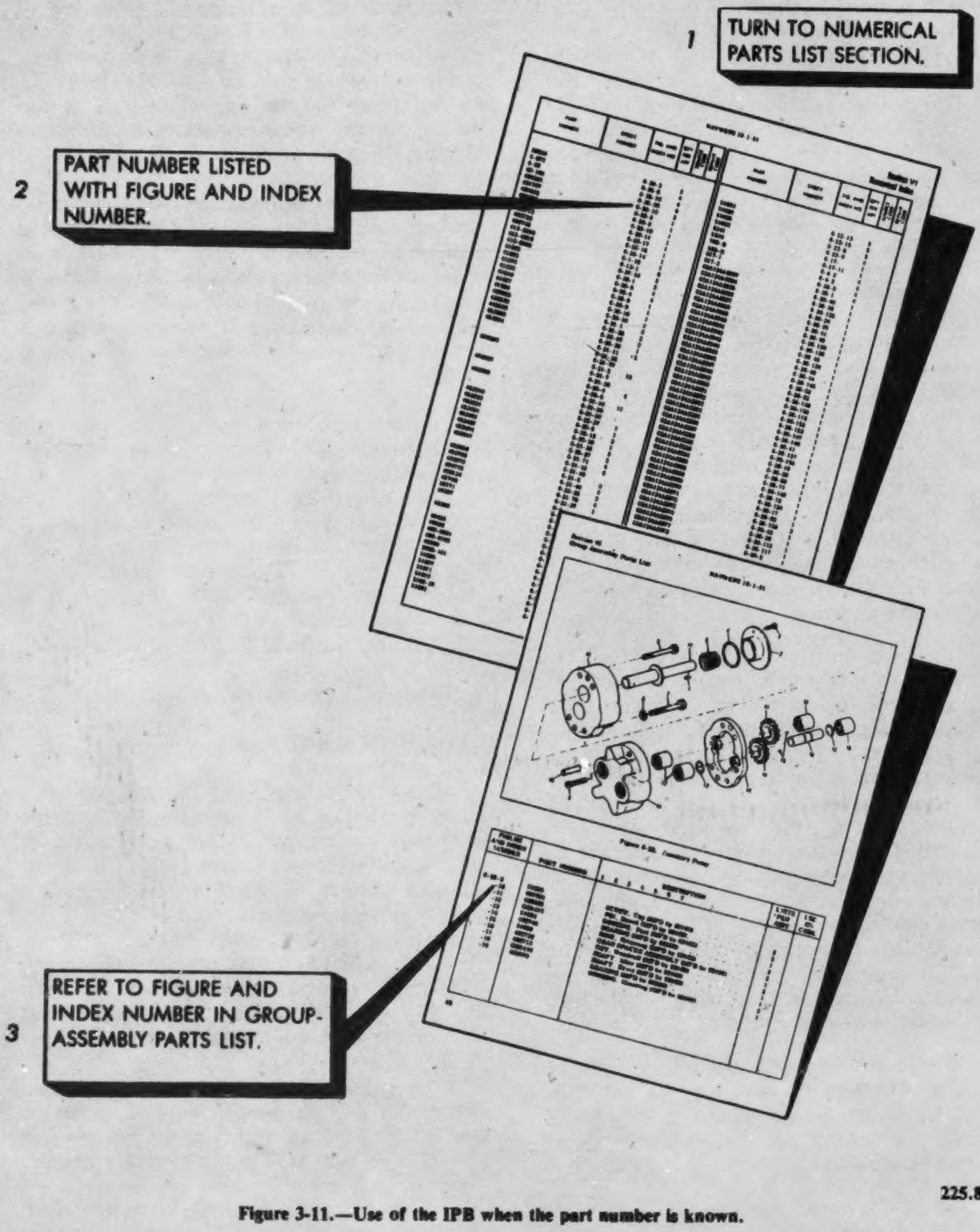
3 FIND THE TITLE OF THE ILLUSTRATION ON WHICH THE PART SHOULD BE SHOWN.

4 TURN TO ILLUSTRATION AND FIND THE PART.

5 REFER TO SAME FIGURE AND INDEX NUMBER ON PARTS LIST.

225.7

Figure 3-10.—Use of the IPB when the part number is unknown.



1 TURN TO NUMERICAL PARTS LIST SECTION.

2 PART NUMBER LISTED WITH FIGURE AND INDEX NUMBER.

3 REFER TO FIGURE AND INDEX NUMBER IN GROUP-ASSEMBLY PARTS LIST.

225.8

Figure 3-11.—Use of the IPB when the part number is known.

Ground Support Equipment Cleaning and Corrosion Control, NAVAIR 17-1-125

This is a new publication (Jan 80) that was designed for Ground Support Equipment. Before this GSE publication, AS personnel were required to use the *Aircraft Corrosion Control Publication,* NAVAIR 01-1A-509, which you now use as a supplemental publication.

The purpose of the manual, *Ground Support Equipment Cleaning and Corrosion Control,* NA 17-1-125, is to provide instructions for the determination and effective control of corrosion on Navy Ground Support Equipment (GSE). In addition, the manual establishes requirements for corrosion control at the organizational and intermediate maintenance levels. This manual is used with, and supports the *Maintenance Instruction Manual* (MIM) and *Service Instruction Manual* (SIM), for the equipment you are working on. If there is a conflict between these manuals on materials or procedures for corrosion control, GSE *Cleaning and Corrosion Control* takes precedence.

The manual briefly defines corrosion in terms of how and why it occurs, and methods for its control. It describes the common methods of cleaning and treating corroded metal surfaces in preparation for painting. There is a section in this manual called Coating Systems. This section covers the coatings that are applicable to GSE (paints, primers, and chemical conversion coatings). There is a preventive maintenance section which provides general guidelines for an effective corrosion prevention program and a section on corrosion control of specific problem areas and corrsion-prone areas of GSE. An appendix in the manual has a list of available tools and materials required to perform the procedures included in the manual.

The Index and Application Tables for Mobile Electric Power Plants, NAVAIR 19-45-1, contains all the descriptive information and illustrations that you need to identify mobile electric power plants.

The Index and Application Tables for Aircraft Jacks, NAVAIR 19-70-46, is an authoritative listing of approved jacks for all Navy and Marine Corps aircraft. It lists the prime jacks and alternate jacks for each aircraft, and it also lists for you the position (wing, axle, fuselage, etc.) that the jack can be used. It also has data on associated repair kits, leg extension kits, and technical publications for jacks.

The Military Standardization Handbook, *Technical Information File of Ground Support Equipment,* MIL-HDBK-300B, is a consolidated source of information about individual items of ground support equipment used by the Navy, Air Force, and Army. It consists of several volumes and provides descriptive information such as:

1. Official nomenclature of the item
2. Manufacturer and model/type number
3. Functional classification
4. National stock number
5. A photograph or drawing of the item
6. Functional description (purpose)
7. Its relation to other equipment
8. Electromechanical/mechanical description (technical details)
9. Reference data and literature available about the item
10. Shipping data (size, weight, etc.)

UPDATING MANUALS

Modern technology is a constantly changing thing. What is considered to be the "latest" word today may be modified, totally revised, or otherwise made obsolete tomorrow. This is not always a planned or intended condition, but it must be accepted and dealt with.

These changing conditions apply to aeronautic technical publications, so you will find yourself constantly updating the technical information and data that you use.

Some changes may be more important than others, but they all must be entered sooner or later. Don't let changes stack up on you. Make it a practice to keep your publications up to date.

Copies of changes and revisions received by automatic distribution are first delivered to the technical library. Personnel of the library make necessary changes to the publications filed in the library. However, the changes to the publications held by the production divisions are routed to the appropriate work center's librarian along with a Change Entry Certification (CEC), OPNAV Form 5070/12. CEC is used to maintain control of changes and revisions. The central library uses the two-part CEC to assure that the changes are made by the work center librarian. The central library first fills in the blocks for the short title of the publication being changed, the local copy number assigned to it and the change or correction numbers. Under Remarks in Part 1, the central library supplies overall direction for incorporation of the change and any other information it feels the work center might need. Most libraries require the old pages or replaced publication to be returned as an extra step to ensure the changes have been made. If this is to be done, the special instruction should be entered in the Remarks block.

Your librarian at the work center acknowledges receipt of the change by signing Part 1 of the CEC and returning it to the central library. If you are incorporating the change, you will sign and date Part 2 of the CEC form and return one form for each change incorporated.

The changes or revisions may direct write-in changes, provide replacement/additional pages, and/or provide information affecting various parts of the manual, in which case the information is prepared as supplemental data.

When incorporating changes, you should follow the instructions provided on the front page of the change. Write-in material should be entered neatly and legibly using indelible ink. Text material to be deleted should have a single line ruled neatly through every line of type.

Supplemental data is printed on pages which you file next to the affected pages in the manual. Supplementary pages are inserted in the manual in page number order and are identified by a letter added to the page number. For example, if a supplementary page is issued bearing the number 2-16A, it is placed between pages 2-16 and 2-17. The supplementary information may be applicable to either pages 2-16, 2-17, or both of the pages.

Replacement pages replace pages already in the basic publication. They are numbered in exactly the same way as the pages they replace. The date of the change is shown on the bottom of the page in the corner opposite the page number. Before you put replacement pages into a publication, count them. When the change has been entered, count the removed pages to make sure that the same number were removed as were put in. Also, the bottom of each removed page should be checked for dates to make sure no new replacement pages were inadvertently missed.

On the back of each change notice cover page is a cumulative list of all changed/revised pages issued and the date of issue since the basic date of the manual. Checking the listed pages and dates against the corresponding pages of the manual, which are also dated, is one good method of determining currentness and completeness of the manual. This page becomes the cover page of the revised manual.

In addition to the normal technical manual change and revision system described above, a Rapid Action Change (RAC) system has been developed to get urgently required information into the field quickly. Under this system, information affecting flight safety, hazards to personnel, equipment damage, aircraft system or component failure, or grounding of aircraft is transmitted to concerned activities by naval message and they immediately incorporate it into the affected manual. RAC's must be entered within two working days of receipt and routine changes are to be incorporated within five working days. Return the second part of the CEC to your central library within these time limits.

LETTER-TYPE DIRECTIVES

There are two broad categories of letter-type directives. One category is used to pass out technical information and includes Bulletins and Changes. These are Technical Directives. The other category pertains to policy and administration procedures. The Instructions and Notices which have previously been described, make up this category. These two forms of letter-type directives are discussed in the following paragraphs.

Technical Directives

The Technical Directive System controls and issues all technical directives, such as those which direct you to perform modifications and onetime inspections of ground support equipment as well as of aircraft and other aeronautical equipment. Therefore, the Technical Directive System is an important element in the programs you use to maintain equipment in a safe and current state of operational and material readiness.

This system provides for two types of technical directives. The difference between the two is the method of their dissemination. The two types are Formal (letter-type) and Interim (message-type). As opposed to the manuals we have discussed, they are both considered as letter-type publications. They contain technical instructions or information which cannot be disseminated by revisions or changes to technical manuals. However, technical directives often require you to change or revise the applicable technical manual, along with performing the directed modification of equipment.

A Formal Technical Directive is issued as a Change, or as an amendment or revision to a Change and is disseminated by mail. A "change" as used here, is a direction to accomplish and record a modification to support equipment, aircraft and related equipment.

A Bulletin is a message-type document comprised of instructions and information which directs a one-time inspection for a given condition. It specifies what action is to be taken if the given condition is found or not found. Some bulletins may contain instructions for corrective action but bulletins will not authorize any change to the material or configuration of the equipment involved.

An Interim Technical Directive is either a Change or a Bulletin, or an amendment or revision of a Change or Bulletin. In order to get to the concerned activities quickly, it is sent as a message. The Interim Technical Directive is only used when it is necessary to inspect or correct a safety or operational condition which is too important to risk waiting for a Formal Directive.

Each Interim Change is followed up by a Formal Change directive which has the same number as the Interim Directive and which replaces it. Interim Bulletins, however, are not superseded by Formal Bulletins.

Sometimes a Change or Bulletin is not the answer to a problem, and it is necessary to amend or revise a Technical Directive. An Amendment is used to do this. It is a document comprised of information which clarifies, corrects, adds to, deletes from, makes minor changes in requirements to, or cancels the existing directive. Notice that an Amendment modifies another publication, while Changes and Bulletins direct specific operations on equipment. An Amendment is only a supplement to the existing directive and not a complete directive in itself. A maximum of three amendments may be applied to any Technical Directive (TD), each remaining in effect until rescinded or superseded by a Revision. If the Technical Directive needs more changes, a Revision must be issued.

A Revision is a completely new edition of an existing Technical Directive (TD). It supersedes the original directive and all existing Amendments.

A rescission of a TD is its cancellation after all its requirements have been completed. The final rescission action is given in NAVSUP Publication 2002 (microfiche).

Cancellation of a TD is the process by which a TD is removed when it is determined that it should not be incorporated. When this is determined, an Amendment is issued to cancel the TD.

Changes and Bulletins are automatically distributed to all activities on the appropriate distribution list.

The title of a Change or Bulletin for support equipment consists of three parts. Part one is the term "Support Equipment," part two, the word or words "Change," "Interim Change," or "Interim Bulletin," and part three, the sequential number. When applicable, the terms "Rev. A," "Amendment 1," etc., follow the basic directive title.

66

Changes are classified by various "action" categories. Bulletins may also be assigned an action classification, but it is not mandatory. The assigned action category tells you the priority for compliance with the directive.

The category "Immediate Action" is assigned to directives which are issued to correct unsafe conditions, which if not corrected would probably result in fatal or serious injury to personnel, or extensive damage or destruction of property. Immediate Action directives take unsafe equipment out ot service until the directive has been compiled with. In some cases action may be deferred up to 120 days (see Table 3-4). Immediate Action directives are identified by a border of black X's on the cover page, broken at the top center of the page by the words "IMMEDIATE ACTION," printed in black.

The category "Urgent Action" is assigned to directives which are used to correct unsafe conditions which could result in personnel injury or property damage. This category of directive is identified by the words "URGENT ACTION" printed in black ink at the top of the first page and a border of black diagonal lines, like the slash line on a typewriter, around the cover page.

You must comply with an Urgent Action Directive not later than the next regularly scheduled rework or overhaul of the equipment. If the equipment does not have a regular overhaul schedule, comply with the directive within 18 months.

Routine Action directives are issued when there are deficiencies which could become a hazard through prolonged usage or have an adverse effect on the operational life or general use of equipment. Comply with routine action directives not later than the next regularly

Table 3-4.—Technical directives priority system

Action classification	Type directive	Situation	Time limits for compliance
Immediate	Interim or Formal	Use of the equipment INVOLVES use of the affected component or system in normal or emergency operation.	Prior to further use of the affected equipment.
		Use of the equipment DOES NOT INVOLVE use of the affected component or system in either normal or emergency operation.	Not later than 120 days after issuance.
Urgent	Interim	Use of the equipment INVOLVES use of the affected components or system in normal or emergency operation.	Not later than next regularly schedule rework or overhaul.
		Use of the equipment DOES NOT INVOLVE use of the affected component or system in either normal or emergency operation.	Same as above.
	Formal	Any	Within 18 months of the date of issue.
Routine	Formal	Any	Within 18 months of the date of issue.

scheduled overhaul or rework, or for equipment not reworked or overhauled on a scheduled basis, nor later than 18 months after issuance of the directive. If, however, accomplishment of the work requires depot level maintenance capability, and the required action will seriously interfere with operational commitments or schedules, you may defer compliance. Routine Action directives are identified by the words "ROUTINE ACTION" printed in black capital letters at the top center of the cover page and no border symbols are used. Table 3-4 illustrates the technical directives priority system just described.

A Record Purpose category is assigned to a technical directive which describes modification that has been completely incorporated by the contractor before acceptance of the equipment by the Navy. This category of technical directives merely documents the action for configuration management purposes. Consequently, compliance is not required. They are identified by the words "RECORD PURPOSES" printed in black capital letters at the top center of the cover page.

TECHNICAL PUBLICATIONS LIBRARY

A Technical Publications Library (TPL) is maintained in each aircraft maintenance department. Management of the TPL is a function of the QA division. The TPL personnel determine what technical manuals are required to support the maintenance organization. They receive, distribute, and control these manuals, as well as ensuring that changes are entered for updating manuals distributed throughout the maintenance organization.

As an AS you will be more concerned with the Dispersed Library which is the library that is in your division. At one time or another you will probably be assigned as the publications PO and be responsible to your supervisor for all publications in the division. When assigned as publications PO, one of the first things you should do is go to your central TPL (in QA) and spend some time with the AZ charged with maintaining it so you may obtain a good understanding of the operation of a library.

TECHNICAL PUBLICATIONS FILING AND STORAGE

NAVAIR technical manuals and directives are drilled with five distinctive holes—three large and two small. The three large holes fit the post of the special NAVAIR publication binders. The two small holes are provided to permit use of standard three-ring looseleaf binders. Binder storage provides a uniform means of protecting as well as controlling the storage of loose documents. The NAVAIR binders are available in two- and three-inch sizes. National Stock Numbers for these binders are:

2" Binder- 7510-00-889-3519 Distribution Code 9Q

3" Binder- 7510-00-889-3520 Distribution Code 9Q

Each manual/directive received should be placed in one of these binders which has a vinyl envelope spline into which an identification strip is inserted. This strip should identify the manual/directive number and title. More than one manual/directive may be placed in the same binder (depending on thickness). In this case, the number of the directives in the binder should appear in the spline window or the inclusive numbers, such as NAVAIR 5200-5212. Publications that are used often should be filed one to a binder. Commercial manuals that have been assigned NAVAIR numbers are filed along with NAVAIR manuals. Those commercial manuals without NAVAIR numbers should be filed in a separate file. The binders should be placed on shelves so that the manuals are arranged in alphanumeric order by publication number.

In a similar manner, MIARS cartridges are arranged in alphanumeric order by cartridge number sequence and stored in an appropriate storage cabinet or container with the cartridge end label readily visible. Letter-type directives should be filed in individual binders numerically. Therefore, there should be binders for changes and binders for bulletins.

Miscellaneous publications also should be filed in looseleaf binders. Two Naval Warfare

Publication Library (NWPL) cards should be prepared for each publication regardless of type and filed in record card files. You should have one card index by NAVAIR number and one by model or part number as a cross-reference for all publications.

MAINTENANCE INFORMATION AUTOMATIC RETRIEVAL SYSTEM (MIARS)

The Maintenance Information Automated Retrieval System, hereafter referred to as MIARS, projects and prints out information from maintenance manuals which is contained on 16mm microfilm cartridges.

To you, the technician who maintains GSE and on whom its safety depends, the delay between the time a technical manual change is issued and the time that change is translated into a repair is DANGER TIME in which naval personnel and equipment are exposed to possible injury or destruction. Any method that shortens or eliminates this DANGER TIME is a way to increase safety.

MIARS provides the aviation maintenance man with required technical information in a more efficient way than was possible with conventional printed manuals. This new system means fast access to up-to-date, accurate, technical information, and you no longer have to lug heavy paper manuals to your working area. All you handle is a 4-inch square cartridge in which the roll of microfilm is encased. Each MIARS cartridge contains approximately 2700 pages of information. The reader-printer (figure 3-12), on which the microfilm page can be

227.97

Figure 3-12.—AR-150A reader-printer.

227.98

Figure 3-13.—AR-151A portable reader.

displayed is near your work site, where its automatic retrieval system is ready to use and its printer can make copies of those pages you require for the job at hand.

In addition to cartridges of microfilm MIARS requires two basic pieces of hardware: The AR-150A reader-printer (figure 3-12) and the smaller AR-151A (figure 3-13) portable readers. The reader-printers have a keyboard for finding microfilm pages and a printer which can make up to seven copies of a microfilm frame. The portable readers are basic projectors that magnify and display microfilm information.

CHAPTER 4

AVIATION SUPPLY SYSTEM

You have often heard that "The only permanent thing in supply is change." This statement may be slightly exaggerated, but at times it sounds quite true. The important thing to remember is that changes in supply procedures are necessary to keep pace with the changing maintenance concepts of the modern Navy. New systems and equipment are constantly under development in today's Navy. Therefore, new systems and procedures are being developed in the Navy supply system to ensure that supplies and materials are available in the right quantities, at the right place, and at the right time.

The primary objective of the Navy supply system is to achieve a balance between the supply of materials and the material requirements of the Department of the Navy. The aviation supply system must achieve this objective for the aeronautical material segment. It must be emphasized at this point that the aviation supply system is not separate and distinct, but is a segment of the integrated Navy supply system. The procedures and organization in this chapter are appropriate to the aviation segment and are frequently equally appropriate to other segments of the supply system.

One of your tasks as an Aviation Support Equipment Technician (AS) is to ensure that needed material is available to complete work assignments. To ensure that this material is available you must work closely with supply personnel. To do this, you must have a working knowledge of the supply system and its application to the maintenance of support equipment.

If you, an Aviation Support Equipment Technician, are to advance to third or second class petty officer, you must become more involved in the details of rendering material support for the completion of the job. It is a requirement that you develop tact, job knowledge and a "team" attitude to get the best possible supply support to complete your shop mission.

ORGANIZATION AND FUNCTION OF NAVY SUPPLY

To better understand the relationship of the Naval Supply Systems Command to the aviation supply system, you should review how the Navy supply system was developed.

In 1921 the Bureau of Aeronautics (BuAer) came into being and assumed the responsibility of procuring aircraft and aircraft engines. The responsibility for procuring spare parts and other aeronautical material remained with the Naval Aircraft Factory, located in Philadelphia, and which until 1941 was the aviation supply center of the Navy.

The Aviation Supply Office (ASO) was established in 1941 under the technical control of BuAer and the management control of the Bureau of Supplies and Accounts. The functions were the procurement, custody, and issuance of aeronautical spare parts and technical material. This is essentially the function of ASO today under the technical control of the Naval Air Systems Command (NAVAIR). Management control of ASO is under the Naval Supply Systems Command.

The Commander, Naval Supply Systems Command, is usually a rear admiral appointed by the President for a term of 4 years with the advice and consent of the Senate. He works with the delegated authority of the Secretary of the Navy. All policies and procedures of the aviation supply organization have the full force and effect of SECNAV orders.

RESPONSIBILITIES OF THE NAVAL SUPPLY SYSTEMS COMMAND

The general functions of the Naval Supply System Command include several areas which may not apply to the AS. Listed below are some of the more important general functions of the Naval Supply Systems Command:

1. Supervises the procurement, receipt, custody, warehousing, and issuance of Navy supplies and materials, exclusive of ammunition, projectiles, mines, explosives, and medical supplies.
2. Supervises and directs the operation of the supply phases of the Navy supply system and administers the redistribution program of excess personal property within the Department of Defense and the sale of Navy surplus property.
3. Authorizes and supervises the transportation of Navy property.
4. Prepares budget estimates and administers funds for the supply distribution system.
5. Renders an annual report to the Congress of money value of supplies on hand at the various stations at the beginning of each fiscal year, the disposition thereof, purchase and expenditure of supplies for the year, and balance on hand.
6. Coordinates (cooperation toward a goal) the compilation and arranges for the printing of the Catalogs on Navy Material.

Some additional functions of the Navy Supply Systems Command that are of interest to AS personnel are the general functions of the Aviation Supply Office (ASO). The ASO is the primary Navy Inventory Control Point (ICP) that is responsible for material support of the Naval Aviation Maintenance Control Program, with respect to technical aviation material. Technical aviation material are items such as spare parts for aircraft, engines, avionics, electrical, accessories, safety equipment, and ground support equipment. The Aviation Supply Office has the responsibility for the budgeting, funding, procurement, disposal and transfer of equipment within the Naval Aviation Maintenance Program.

APPROPRIATIONS

At one time or another, you may have had the frustrating experience of not being able to draw from supply some item needed immediately. The usual reason given is: "We do not have any money left." Obviously, the Navy operates with limited funds. This section and the following section, titled "Operating Budgets," are presented to help you better understand how money can be available for operating expenses.

The main money pool of the government is the General Fund of the Treasury. Funds come into the General Fund from such sources as income taxes, import-export taxes, etc. The only way for money to be expended from the General Fund is by congressional action, which has to be approved by the President. A congressional bill which includes spending of funds from the General Fund is called an appropriation.

An estimate of the amount of money required for the operation of the Defense Department during a given fiscal year is prepared by the Department of Defense before the beginning of the fiscal year. The Congress studies the proposed budget in the light of world affairs, the current domestic economy, and such other considerations as they see fit. Congress may increase the amount requested, decrease it, or pass it as is. After presidential action is completed, the money is made available to the Department of Defense to be spent during a specified year. This is known as an "annual" or "one-year" appropriation.

Congress and the President may also approve "no-year" appropriations for special projects such as large construction programs over an unspecified length of time.

Another form of appropriation is the "multiple-year" appropriation for projects which will be completed in a predictable length of time. An example of the use of this type of appropriation is the money appropriated to cover the expenses of the NROTC college programs for the next four years.

The appropriation which affects you most is the "current-year" appropriation. After the appropriation expenditure authorization is received in the Department of Defense, it is prorated among the services as a percentage of their previously submitted budget estimates. The

Navy's share is prorated among the various sytems commands and bureaus in essentially the same manner; that is, as a percentage of their estimated requirements for the coming fiscal year. The money to be spent for naval aviation is made available to NAVAIR. Here, part of the money is given to ASO to buy aviation spare parts (support equipment parts included) based on past use rates and needed for the coming year. These spare parts are furnished to your activity at no cost, since their usage had been anticipated and the items paid for in advance. The account from which money was spent to buy these items is known as the Appropriation Purchase Account (APA).

OPERATING BUDGETS

Approved operating budgets for naval aviation are authorized by NAVAIR to your activity to spend a certain amount of money during a given length of time for specified purposes. User activities are shore commands, which operate aircraft, and the major air type commands.

Operating funds are given by NAVAIR through the operating budget to stations, rework facilities, and other like activities who operate and maintain aircraft and related equipment. Departments within these organizations normally submit their department budget to the station comptroller who reviews and combines the different department budgets into a recommended station budget. The senior AS in your shop may be called upon to assist in furnishing a realistic estimate of division operating expenses and future needs which the department head may use in preparing the department budgets.

The normal aviation operating funds for squadrons and units come from their type commanders as an Operating Target (OPTAR). Routine operating funds for other than aviation expenses are absorbed by their parent ship or station.

OPERATING TARGETS

An OPTAR is a planned estimate which the air type commander allocates for the financing of aircraft operating costs during a given period of time. OPTARs are issued quarterly and unused funds from the previously issued OPTAR revert to the control of the type commander as each new OPTAR is authorized. Type commanders provide OPTARs to squadrons, units, and ships under their operational control, whether or not the user activity is based ashore.

There are several different types of OPTARs issued by the air type commanders for aviation purposes. Of these funds, the most important to you are the aircraft maintenance funds. The funds are discussed briefly in the following paragraphs.

Aircraft maintenance funds are provided to Organizational and Intermediate maintenance activities to finance the cost of various supplies and materials for aviation maintenance. These funds finance the following:

1. Repair parts, common hardware, lubricants, cleaning agents, cutting compounds, metals, and other materials incorporated into or expended in the performance of aviation maintenance of aircraft, engines, aeronautical components and subassemblies, and Navy maintenance of ground support equipment.
2. Fuels and lubricants consumed by aircraft engines in the performance of complete section repairs.
3. Fuel and lubricants consumed in ground support equipment.
4. Safety/flight deck shoes used in maintenance work centers and with ground support equipment.
5. Preexpended, consumable maintenance material.
6. Replacement of expendable and consumable items.

AIRCRAFT MAINTENANCE MATERIAL READINESS LIST (AMMRL) PROGRAM

For effective management of all levels of aircraft maintenance, a single unified overall program is necessary. Such a program exists. It is called the Aircraft Maintenance Material Readiness List Program or AMMRL. This program involves over 20,000 aircraft maintenance support equipment line items. These items are used throughout the Navy by aircraft maintenance activities. AMMRL also involves the many ship and base loading combinations and the requirements for airframe configurations, power plants, and avionics systems. AMMRL has as its objective the data and in-use asset information concerning Ground Support Equipment (GSE). This data can be used by your supervisor for the following purposes:

1. To establish allowance requirements for GSE at the intermediate or organizational maintenance activities.

2. To redistribute in-use assets.

3. To establish a base for GSE budget requirements.

4. To evaluate material readiness.

Ground Support Equipment (GSE)

GSE includes all equipment on the ground to make a weapons system (in aircraft), support system, subsystem, or end item of equipment operational for its proper use. This also includes all equipment required to: install, launch, arrest, inspect, test, adjust, calibrate, assemble, disassemble, handle, transport, safeguard, store, service, repair, overhaul, maintain, or operate the system, subsystem, end item, or component.

Application Data for Material Readiness List (ADMRL)

The ADMRL consists of data specifying the requirements for each item of GSE as applied against intermediate and/or organizational level of maintenance and selected ranges for each type of aircraft, engine, and avionics system. These data are stored in computers and used to develop Intermediate Material Readiness Lists (IMRLs).

Individual Material Readiness List (IMRL)

The IMRL is a (combined) listing of GSE that is required by an activity to perform its assigned maintenance function. It is maintained by that activity reporting all on-hand assets as they are received, inventoried, and transferred. It is extremely important that these transactions about IMRL items be reported as they occur.

Accountable Item

The term accountable item applies to all GSE assigned report code "R." Report code R is assigned to all repairable Intermediate Material Readiness List (IMRL) items of GSE in addition to all other GSE costing $200 or more. A status change (gain, loss, survey) or a report code R item requires a transaction report to be filed. Non-repairable GSE and/or items costing less than $200 are assigned report code "C" (consumables) in IMRLs and are not reported when their status changes.

Excess "In-Use" Accountable GSE

This includes items of GSE which meets any of the following criteria:

1. An authorized IMRL item which is not considered to be needed in the authorized or allowed quantity.

2. A quantity in possession of any aircraft maintenance activity which exceeds the authorized IMRL quantity, or the quantity authorized by the Aircraft Controlling Custodian, these are commands that direct the movement of aircraft. The following commands are ACCs:

   a. Naval Air Systems Command
   b. Commander Naval Air Atlantic/Pacific
   c. Chief of Naval Air Reserves
   d. Chief of Naval Air Training

3. Any on-hand quantity of GSE which has been deleted from the activity's present IMRL.

Alternate Item

As used in this section, an alternate item is an interchangeable or substitute for the desire item (which is called a "prime" item in this chapter).

MATERIAL ALLOWANCE DOCUMENTS

Aeronautical material and equipment required for the operation and maintenance of aircraft, air-launched weapons, and aeronautical systems are normally furnished through one or more of the following allowance lists:

1. Aviation Consolidated Allowance List (AVCAL)
2. Coordinated Shipboard/Shorebased Allowance List (COSAL/COSBAL)
3. Individual Material Readiness List (IMRL)
4. NAVAIR Allowance List (AL)
5. NAVAIR Initial Outfitting Lists (IOL)
6. Allowance Equipage List (AEL)
7. Allowance Parts List (APL)
8. Tables of Basic Allowances (TBA)

The Aviation Supply Office (ASO) publishes a microfiche consolidated listing of all aeronautical allowance lists (ASO publication ARR-100, Allowance Requirements Register). This publication is updated quarterly and sent to various aviation activities by an ASO controlled distribution list.

SUPPLY DEPARTMENT ORGANIZATION

Material management and supply support requires and involves a direct relationship between two complex operations—maintenance and supply. These operations must have a single point of contact for coordinating actions common to both operations. The success of material management and supply support in the Intermediate Maintenance Activity (IMA) depends largely on this cooperation. Both supply and maintenance personnel must be familiar with the local organizational structure. Material Control Centers (MCCs) and Supply Support Centers (SSCs) are contact points for material and supply matters.

MATERIAL CONTROL FUNCTIONS

Material control serves as the single point of contact within the maintenance organization for conducting business with the supply organization.

When an organization is in need of a component, the production work center requesting the material furnishes identification of the required item in the form of a part number and manufacturer's code from an Illustrated Parts Breakdown (IPB) or other technical reference. The request is forwarded through maintenance control for assignment of a priority indicator and project code. Then the request is passed to material control, and forwarded to the SSC.

Listed below are some examples of material support provided by Material Control in the cognizant organization:

1. Ensuring that maintenance requirements for parts and material are properly forwarded to the SSC in a timely and continuous manner to keep from stopping work or grounding the aircraft.
2. Ensuring that parts and material received are expeditiously routed to applicable work centers and are not allowed to accumulate.
3. Establishing delivery/pickup points for all material as mutually agreed to by Supply and Maintenance Officers.
4. Maintaining liaison with the supporting SSC on maintenance material matters to ensure that material needs of the organization are satisfied.
5. Preparing documents for materials required for operational support of weapons system (i.e., material chargeable to funds such as aviation fuel, lube oil, flight clothing, etc.) and material carried in SERVMART/JETMART (Service/Jet Market) outlets.
6. Maintaining control/records to ensure the turn-in of defective components within established time frames.

Some functions which apply only to the intermediate level of maintenance are listed in the following paragraphs.

Intermediate Level

An Administrative Screening Unit has been established in Material Control for intermediate maintenance activities. This screening unit does the following:

1. Positively identifies material and determines if it is within the repair capability of the Aircraft Intermediate Maintenance Department.
2. Ensures that all required documentation is affixed to the component (i.e., logs, records, VIDS/MAF, etc.).

3. Notifies maintenance/production control that defective components have been received for scheduling into the AIMD.
4. Transfers the defective components to the appropriate work center when directed by maintenance/production control.

All components received in the AIMD material control receive screening to determine whether the item is within the check, test, or repair capability of the AIMD. As a result of this screening, components requiring maintenance in the AIMD are reported to maintenance/production control as "Ready For Induction". Items beyond AIMD's ability to correct are returned to the Supply Support Center with appropriate recommendations for disposition. When the work in the AIMD has been completed, the components, together with required records, are returned to Material Control for appropriate routing.

Organizational Level

In addition to the general functions, the material control work center in organizational level activities will:

1. Verify NORS (Not Operationally Ready Supply) requisitions and maintenance of current NORS status records.
2. Inventory aircraft when they are received or transferred and maintain inventory records.

When components are removed as a result of maintenance, material control will ensure that the SSC is notified to pick it up. These components must be accompanied by record cards and logs, when applicable, plus a five parts VIDS/MAF.

SUPPLY SUPPORT CENTER

Maintenance organizations have one point of contact with the supporting supply activity. This single supply contact point is the Supply Support Center (SSC). The SSC responds to all material requirements of the maintenance organizations. The SSC is an internal organization of the local supply activity. It is made up of two sections—the Component Control Section and the Supply Response Section.

The amount of support provided is dependent upon the operating hours of the maintenance activities that the center supports. If maintenance is being performed 24 hours a day, then supply support is available 24 hours a day.

The center maintains the Local Repair Cycle Asset (LRCA) formerly known as the "Rotable Pool." The LRCA is a gathering place for frequently used parts that require frequent reordering. Proper management of the LRCA depends on having a realistic stock level for reordering. This is the stock level at which further use of a part or material will likely result in the activity being unable to do its mission. The assignment of a low limit (point for reordering) may be based on any sensible set of standards or limits, i.e., average number of daily issues per related (family) group/Work Unit Code (WUC); items with an allowance of two or less are always at this low limit. The use of low limits allows for timely notification to Aircraft Intermediate Maintenance Department (AIMD) of LRCA upcoming shortages and permits a potential "Not in Stock" (NIS) situation to be cleared up prior to the actual NIS event.

COMPONENT CONTROL SECTION (CCS)

The CCS is the section of the Supply Support Center (SSC) that is responsible for management of repairable items. CCS must account for all repairables stored in the LRCA storage areas, in the AIMD repair cycle, and in process for shipment to Designated Overhaul Points (DOPs). CCS is divided into the following sections:

1. Document Control Unit (DCU)
2. LRCA Storage Unit
3. Supply Screening Unit (SSU)
4. Awaiting Parts Unit (AWP)

Document Control Unit

This unit is responsible for the control of components and their documents such as:

DOCUMENT SUSPENSE.—This file contains the white copy of the DD Form 1348 received from the Technical Research Unit, indicating that a demand for a repairable component was received, but other than Expeditious Repairs (EXREP).

EXCHANGE DUE FILE.—This file contains the yellow copy of the DD Form 1348, received from Material Delivery Unit, indicating that a defective turn-in is to be received.

INDUCTION RETURN DUE FILE.—This visual file contains the Visual Information Display System/Maintenance Action Form (VIDS/MAF), Copy 2, received from the AIMD. This shows that a part is to be inducted into the AIMD. When the defective components are processed without an exchange ready-for-issue component, the Copy 2 of the VIDS/MAF will show that the component has been inducted into the AIMD. No other copies of DD Form 1348 are filed.

Local Repair Cycle Assets (LRCA) Storage Unit

The LRCA storage unit is responsible for the receipt, storage, and accountability of repairable assets (components, units, and parts). LRCAs are part of an activity's repairable Operational Support Inventory (OSI—fixed allowance) and are in a central location to allow for rapid issue to Organizational Maintenance Activity/AIMD. This includes returning RFI components to the LRCA storage area or the stock warehouse and sending non-RFI (equipment to be repaired) components to the Designated Overhaul Point (DOP).

SUPPLY SCREENING UNIT (SSU).—The SSU also keeps a repairable control file. This file contains the yellow copy of the DD Form 1348 for those requisitions for repairable items that could not be filled from on-station sources, such as LRCA, stock, quick repair, etc. This file indicates that the requisition has been forwarded to Main Supply for off-station processing and that a repairable back order has been made.

AWAITING PARTS UNIT (AWP).—The Awaiting Parts (AWP) is responsible for receiving, storing, and controlling all AWP components returned from the AIMD. This unit should be located adjacent to AIMD Production Control. The functions of the AWP unit are:

1. To establish holding and staying areas for AWP components.

2. To requisition lists with prices, maintain requisition files, registers, and records necessary to monitor (check on), follow-up, expedite (speed up), reconcile (re-check or adjust), and report material demands for component repairs.

3. To maintain contact with the Supply Response Section (SRS) on maintenance material matters to ensure delivery of material required to repair components.

4. To receive incoming material, match it to the failed component and when all required material is received, reinduct (arrange with the AIMD the return for repair) components.

5. To continually review and follow up on off-station requisitions to fill AWP requirements.

6. To set procedures to ensure that an unsatisfactory LRCA is reported; that AWP situations are made known to higher authority; and that aid is to be received within a set period of time.

7. To make recommendations on cannibalization (stripping parts from one unit to repair another unit) of AWP components after joint study by both the AWP unit and production control.

8. To set procedures to assign failed components to the next lower level of repair when needed.

Supply Response Section (SRS)

The Supply Response Section (SRS) prepares all necessary requisitions (DD Form 1348) and related documents required to obtain material for local maintenance use in direct support of weapon system maintenance. The maintenance organization verbally notifies the supply organization that the material is needed. When the material is available locally, the time frame for processing and delivery is as follows:

Priority	Process/Delivery Time
1-3	1 hour
4-8	2 hours
9-20	24 hours

The SRS is responsible for the receipt, storage, and issuing of all ready-for-issue pool components. It is responsible for physical delivery of RFI material to maintenance organizations, and the pickup of defective components from the organizational maintenance activity and delivery to the intermediate maintenance activity. You, as maintenance personnel, are not involved in the physical movement of material between organizations.

The SRS also performs technical research in order to complete requisition documents and determine the status of outstanding requisitions and inform the customer about the order.

Uniform Material Movement and Issue Priority System (UMMIPS)

In this system, the priority designator is determined by a combination of factors. These factors identify the importance of the requisitioner FAD (force/activity designator) and the urgent FAD need or end use (indicated by an urgency-of-need designator). The FAD and a Roman numeral I through V, is assigned by the Joint Chiefs of Staff (JCS), Chief of Naval Operations (CNO), and Navy commanders.

Every activity is assigned one of five force/activity designations according to its military importance. The designators are shown in Figure 4-1 and explained as follows:

Force/ Activity Designator	A Unable to perform	B Impairs capability	C Routine
I Combat	1	4	11
II Positioned	2	5	12
III Ready	3	6	13
IV Reserve and support	7	9	14
V Others	8	10	15

Figure 4-1.—Priority Number Chart.

I—COMBAT: The highest order of military importance. This designator is not normally used in peacetime unless approved by the President or the Joint Chiefs of Staff.

II—POSITIONED: United States combat, combat ready, and direct combat support forces deployed outside Continental United States (CONUS) in specific theaters or areas designated by the Joint Chiefs of Staff, and those CONUS forces being maintained in a state of combat readiness for immediate (within 24 hours) deployment or employment.

III—READY: All other United States combat ready and direct combat ready and direct combat support forces outside CONUS not included under designator II.

IV—RESERVE AND SUPPORT: U.S. active and selected reserve forces planned for employment in support of approved joint war plans. This category includes training units and units in training for scheduled deployment.

V—OTHERS: All units not otherwise assigned, including administrative/staff type units.

The Force/Activity Designator is prepared according to the urgency of a requirement in order to determine the priority to be assigned to requisitions. For example, FAD II activities can submit priority 2, 5, or 12 requisitions for material, depending on the urgency of the requirement to mission readiness, while FAD III activities submit priority 3, 6, or 13 requisitions for corresponding requirements.

The priority assigned to individual material requisitions is assigned by maintenance control in accordance with the military importance and the urgency of need of the item. Abuse of the priority system minimizes the effort that the supply system can devote to units directly involved in combat. Instructions for the assignment of FADs are promulgated by OPNAVINST 4614.1 (Series) and are implemented by Fleet Commander and Support Commander instructions.

The urgency-of-need designator (an alphabetical A, B, or C) is determined by maintenance control in the requisitioning activity, with certain exceptions. These two factors (FAD and urgency-of-need) enable the requisitioning activity to determine the UMMIPS priority designator (arabic numeral).

MATERIAL IDENTIFICATION

Aviation Support Equipment personnel work closely with the aviation storekeepers in keeping GSE in an "up" status. In order to obtain replacement parts as rapidly as possible, you must know how to determine the source of supply of different items. For example, you may waste many hours in trying to trace a supply item before you find out that the item can be manufactured within your own activity. Also, it is important to know the correct part number and stock number used to requisition items from supply.

In DOD, the cataloging system uses one name and number per item for all government supply items. When you request material, you should always use supply terms.

NATIONAL STOCK NUMBERS

Prior to 1952, each of the services had its own numbering system for identifying, cataloging, stocking, and issuing items of military supply. It was common for one service to be negotiating on the open market for an item held in surplus by another service under its own stock number. This confusion resulted in the Military Standard Requisitioning and Issue Procedure (MILSTRIP) in 1952 of the Defense Cataloging Standardization Act.

Implementing the Defense Cataloging Standardization Act has reduced the duplication of items among the services by providing for one stock number for each item, regardless of how it is or was used by the using activity.

The standardized numbering system was intended to create and improve standardization of items of military supply in servicewide use and reduce excess inventories which, for the most part, were caused by lack of standardization. Also, reducing inventories saved money by reducing the time material stayed on the shelf. Less items had a chance to become obsolete.

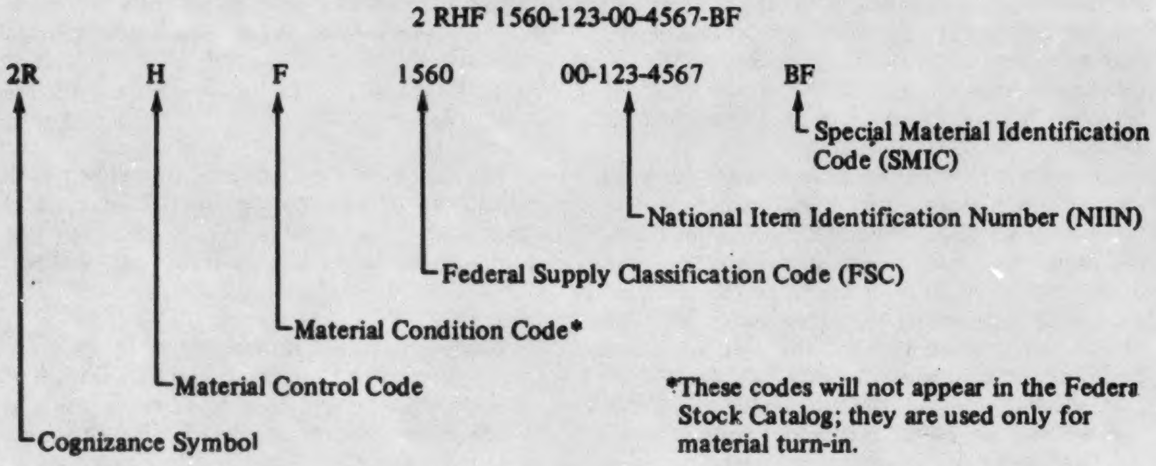
Originally these stock numbers were known as Federal Stock Numbers (FSN), but were changed to National Stock Numbers (NSN) in 1974 in order to comply with item identification requirements of the Status of Forces Agreement of the NATO members.

NOTE: While this chapter applies only to the military, you should know that the national stock numbering system is the prime numbering system for all federal agencies.

Types of Stock Numbers

In the Navy, ASO uses National Stock Numbers with prefixes composed of 1, 2, or 3 symbols, and suffixes composed of 2 characters which may be all letters or a combination of letters and numbers. When the prefixes and suffixes are used, the stock number becomes a Coded National Stock Number, such as shown in figure 4-2.

When the first prefix symbol is used, it designates the command or office having control or cognizance of a particular item. Some of the more common cognizance symbols, together with the type material controlled and the cognizant command or office, are listed in figure 4-3.


2 RHF 1560-123-00-4567-BF
2R
H
F
1560
00-123-4567
BF
Special Material Identification Code (SMIC)
National Item Identification Number (NIIN)
Federal Supply Classification Code (FSC)
Material Condition Code*
Material Control Code
Cognizance Symbol

*These codes will not appear in the Federa Stock Catalog; they are used only for material turn-in.

Figure 4-2.—Breakdown of a Coded National Stock Number.

You will find many variations of coded stock numbers in field maintenance work. These variations indicate material management responsibilities for the item; flag certain items as recoverable, consumable, CLAMP (high usage) etc.; identify the condition of the material if it is not ready for issue.

Because the variety of codes is so extensive and the trend to single service management of items has caused so many changes in recent years, a list of codes that might be prefixed or suffixed to a stock number would not be appropriate for this manual. The primary things to keep in mind are that the basic stock number, consisting of four groups of numerals, identifies the item from a technical point of view, and that the other codes identify material management characteristics.

Material Control Codes

Material control codes divide inventories into segments with similar demand, repairability, or other characteristics. For example, some material control codes are either fast or slow moving, while others are to be repaired either at the intermediate or depot level of maintenance. Management techniques peculiar to various items of material can be easily recognized at all levels of responsibility by this code. In figure 4-4, the stock number example, material control code H designates the item as repairable, subject to scheduled overhaul at designated Navy rework facilities or commercial overhaul. All defective repairable material must be returned to supply for subsequent overhaul upon receipt of a replacement item. Other material control codes used with aeronautical material are listed in figure 4-4.

Material Condition Codes

Material condition codes classify material according to ready for issue and use, or action under way to change the status of material. For example, one material condition code indicates that a particular item is serviceable and ready for issue. If, after issue from the supply system and through use, this item becomes unserviceable, its code is changed to reflect the requirement for repair or overhaul. Upon completion of rework or repair, the material condition code is changed to show that the item is once again serviceable and ready for issue. There are presently 13 different condition codes, indicated by letters A through N (less I), which may be assigned to Navy material. Since these codes apply to specific quantities of material, they do not appear in stock catalogs.

Cognizance symbol	Cognizant inventory manager	Stores account	Technical responsibility	Definition
0I	Naval Publications and Forms Center, Philadelphia.	None	Navy Publications and Printing Service.	Publications.
1I	Naval Publications and Forms Center, Philadelphia.	NSA	Navy Publications and Printing Service.	Forms.
1N	Navy Electronic Supply Office.	NSA	Various systems commands.	Electronic assemblies and repair parts.
1R	Navy Aviation Supply Office.	NSA	Naval Air Systems Command.	Aeronautical, photographic, and meteorological material (consumable or expense type material).
1W	Navy Fuel Supply Office.	NSA	Naval Supply Systems Command.	Bulk and drummed liquid petroleum fuels, bulk lubricating oils, bulk dry-cleaning solvents, calibrating fluids and corrosion preventives, new and used drums, and miscellaneous petroleum items.
2R	Navy Aviation Supply Office.	APA	Naval Air Systems Command.	Aeronautical, photographic, and meteorological material (repairable or investment type material).
2V	Naval Air Systems Command.	APA	Naval Air Systems Command.	Photographic, meteorological, and aeronautical support equipment.
8R	Naval Air Systems Command.	APA	Naval Air Systems Command.	Major aeronautical systems and equipment
9Z	Navy Fleet Material Support Office.	NSA	Various bureaus and commands.	Navy owned stocks of defense industrial material.

Figure 4-3.—Cognizance Symbols.

Code	Definition
A	Field activity control—Items on which continuous centralized item inventory is not exercised.
D	Repairable locally—Capable of being repaired by using activities or their immediate supporting activity.
F	Fast—High system quantity demand.
G	Repairables with unit price of $1,000 or more—Material subject to special transaction reporting from acquisition to final disposition.
H	Repairables other than G, X, or Q, —Capable of being repaired by depot maintenance activities.
J	Consumables with unit price of $1,000 or more—Material subject to special transaction reporting from acquisition to final disposition.
M	Medium—Medium system quantity demand.
Q	Repairable items with unit price of less than $1,000.
R	Insurance—Essential item with unpredictable demand, long lead time, and difficult to procure.
S	Slow—Low system quantity demand.
X	Special Program—Currently assigned to all accountable cognizance 2R and 2V ground support equipment.

Figure 4-4.—Material Control Codes.

STANDARDIZATION OF ITEM NOMENCLATURE

The assignment of names of stock items is as important as the assignment of National Stock Numbers. When items are inducted into the supply system, official government nomenclature must be assigned. Often this item title plus additional descriptive data differs from items previously used. If you have trouble in locating a familiar item in the catalog, it is possible that the title has been changed to a more general usage. For instance, a "swab" is found listed as a small stick with a tiny wad of cotton on one end, and is used by the Medical Department. In order to clean the decks it becomes necessary to think of another name for "swab." Now, "mops" are found listed, together with the correct National Stock Number. Other examples are as follows: "Ceilometer" becomes "Projector, Cloud Height"; "Zipper" has become "Fastener, Slide Interlocking," etc.

MATERIAL IDENTIFICATION AIDS

There may be times when a part or some technical material is needed and the stock number is not known. At other times some material may be on hand and it cannot be positively identified. If you know the many ways that material can be identified, it'll speed up your job. Some information may be available which does not identify an item but may help by getting you to another publication that will. An aircraft part has a part number. The part number may be looked up in the IPB and identified by nomenclature and often by the stock number. If the stock number is not furnished in the IPB, it may be found by referring to Cross-Reference Section C0006 of the Navy Stock List of ASO.

Some equipments have attached nameplates which provide the manufacturer's name, make or model number, serial number, size, voltage, phase, etc. Identification taken from the nameplate of the old part can be very helpful in identifying the replacement.

When only the description of the item is known, the best source for identification is the descriptive sections of the various Navy Stock Lists.

Various publications used in identifying material are described in the following paragraphs.

NAVAL MATERIAL CATALOGS

Federal and naval material catalogs provide the necessary information to identify and order material for the operation and maintenance of activities ashore and afloat. How and which catalogs to use are discussed in the following two sections on identification source data.

Illustrated Parts Breakdown (IPB)

The IPB and allowance lists continue to be the most important source for obtaining information necessary to order specific support equipment parts. Properly used, they provide a reference to identify a part number to a specific model of equipment and in some cases provide interchangeability data that can be used when a prime item is not in stock. The interchangeability of parts is discussed in greater detail later in this chapter.

An Illustrated Parts Breakdown, also known as Illustrated Maintenance Parts List or Illustrated Parts Catalog, is prepared by the manufacturer for each model of aircraft, most items of ground support equipment, engines, accessories, or other aeronautical equipment's identified and issued by NAVAIR. The IPB enables supply and maintenance personnel to identify and order replacement parts for aircraft or equipment. All parts are illustrated and listed for quick identification of assemblies and their component parts. The items are presented and identified with the parts in sequential order of assembly.

Although slight variations in format exist among the various IPBs, each usually includes the following major sections.

The INTRODUCTION includes general information about the equipment, contents and instructions on how to use the IPB.

The GROUP ASSEMBLY PARTS LIST is a breakdown of the complete unit into major components, systems, installations, assemblies, and detail parts. Generally, parts are indexed in disassembly order. In some instances, assemblies or installations are shown in an assembled form on one figure and the detail parts are illustrated in another figure. In these cases, the parenthetical note "(See figure __ for breakdown)" appearing after the description refers to the figure number of the illustration on which the detail parts of the subassembly can be found. The parenthetical note "(See figure __ for next higher assembly)," indicates the figure where the item can be found in assembled form.

The NUMERICAL INDEX lists part numbers in alphanumerical order, and each part number is cross-referenced to the figure and index number where it is illustrated. This section also shows the total quantity of each part used in the equipment, material source code, and federal stock number when applicable.

The REFERENCE DESIGNATION INDEX has been added to later editions of IPBs. This index lists in alphanumerical order reference designators (Example: B1, J1, K7, etc.) for symbols on schematic and wiring diagrams. The index also lists part numbers and index numbers of where the parts are located in the IPB.

When using the IPB, consider if the failed part is one that was installed as a result of a technical directive, then the part number may not appear in the IPB. The index manual for IPB volumes includes a list of directives which have been incorporated into the IPBs. For information on parts where the directive has not been incorporated, the directive may provide the information for ordering a replacement item.

Navy Management Data List

The Navy Management Data List (NMDL) consists of two separate sections. One section, the Fleet Ballistics Missile Weapons System Supplement, applies only to submarine forces and is of little or no use to aviation maintenance personnel. The other section, titled the Management Data List, includes basic management data for preparing material requisitions. Also, it is the instrument for publishing data for stock number changes, unit of issue, unit price, shelf life of material, number of items contained in a package, and associated information.

The NMDL is designed for management type information relating to the NSN. It is not designed to be a comprehensive catalog of material in the supply system or to identify an item to an NSN; therefore, it cannot be used as a shopping guide. It is printed in national item identification number sequence. In order to get the necessary NSN or other information needed to make effective use of the NMDL, additional publications must be used in conjunction with the NMDL. Some of these are discussed in the following section.

Support Equipment Reference Lists (ERLs/SELs)

The ERLs and SELs references are helpful to you in that they provide a two-way cross-reference of all part numbers which apply to specific types of ground support equipment. The lists are made up in two parts.

Part I. Cross-references the part number to the FSCM, NSN, and SM&R code and nomenclature of the item.

Part II. Cross references from the NSN to FSCM and part number.

The lists saves you time when looking up part numbers or stock numbers when a replacement part or item is needed.

Descriptive/Identification Lists and Illustrated Shipboard Shopping Guides

Descriptive type catalogs or Identification Lists (ILs) are available on all NSG group materials. They list catalog material by what it is rather than by what it is used on. These catalogs are similar to the Sears-Roebuck/Montgomery-Ward type catalogs, which have a comprehensive alphabetical index, group like items together, and thoroughly describe the items (size, weight, composition, etc.).

The Illustrated Shipboard Shopping Guides (ISSG) are similar to the ILs. They are designed to assist fleet personnel in identifying those items of supply not normally related to a part number or reference number to an NSN. They also help in determining substitute items by illustrations, specifications, and narrative descriptions from which material can be compared.

The ISSG is a multivolume publication with an introduction and master index plus a number of individual sections which apply to specific national supply classes or groups.

The master index provides an alphabetical sequence listing of all items included in the ISSG, referring to the individual sections (NSC group or class) where they appear. The index is similar to that shown in figure 4-5.

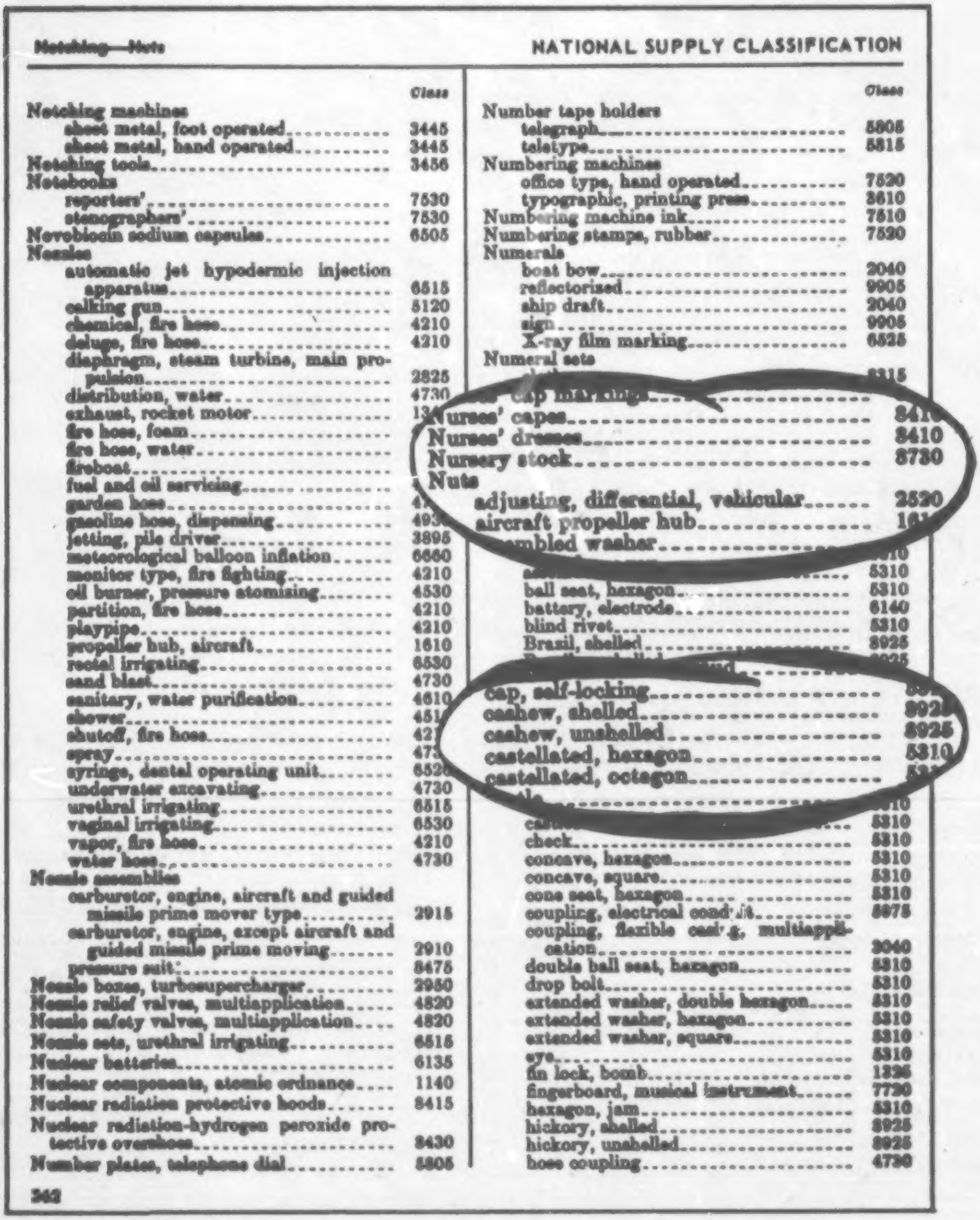
Navy Deleted and Superseded NIIN List (DSNL)

The Navy Deleted and Superseded NIIN List is the historical record of stock number deletions and supersessions. The DSNL is printed in old NIIN sequence and lists old NIINs which have been canceled and cross-references old NIINs to superseding NIINs. In the event that an old NIIN was superseded more than once, it cross-references to the latest NIIN. The change notice code indicates the reason for cancellation or replacement of the old NIIN.

NOTE: The DSNL does not constitute automatic authority to substitute or effect interchangeability. The change notice code should be considered and the items end use application must be known to determine if the superseding NIIN is a valid replacement item.

Source Codes

In 1972 the Navy adopted the Joint Service Uniform Source, Maintenance, and Recoverability (SM&R) Codes. These codes appear



Notching—Nuts

NATIONAL SUPPLY CLASSIFICATION

	Class
Notching machines	
sheet metal, foot operated	3445
sheet metal, hand operated	3445
Notching tools	3456
Notebooks	
reporters'	7530
stenographers'	7530
Novobiocin sodium capsules	6505
Nozzles	
automatic jet hypodermic injection apparatus	6515
calking gun	5120
chemical, fire hose	4210
deluge, fire hose	4210
diaphragm, steam turbine, main propulsion	2825
distribution, water	4730
exhaust, rocket motor	13
fire hose, foam	
fire hose, water	
fireboat	
fuel and oil servicing	
garden hose	47
gasoline hose, dispensing	493
jetting, pile driver	3895
meteorological balloon inflation	6660
monitor type, fire fighting	4210
oil burner, pressure atomizing	4530
partition, fire hose	4210
playpipe	4210
propeller hub, aircraft	1610
rectal irrigating	6530
sand blast	4730
sanitary, water purification	4610
shower	451
shutoff, fire hose	421
spray	473
syringe, dental operating unit	652
underwater excavating	4730
urethral irrigating	6515
vaginal irrigating	6530
vapor, fire hose	4210
water hose	4730
Nozzle assemblies	
carburetor, engine, aircraft and guided missile prime mover type	2915
carburetor, engine, except aircraft and guided missile prime moving	2910
pressure suit	8475
Nozzle boxes, turbosupercharger	2950
Nozzle relief valves, multiapplication	4820
Nozzle safety valves, multiapplication	4820
Nozzle sets, urethral irrigating	6515
Nuclear batteries	6135
Nuclear components, atomic ordnance	1140
Nuclear radiation protective hoods	8415
Nuclear radiation-hydrogen peroxide protective overshoes	8430
Number plates, telephone dial	5805

	Class
Number tape holders	
telegraph	5805
teletype	5815
Numbering machines	
office type, hand operated	7520
typographic, printing press	3610
Numbering machine ink	7510
Numbering stamps, rubber	7520
Numerals	
boat bow	2040
reflectorized	9905
ship draft	2040
sign	9905
X-ray film marking	6525
Numeral sets	
[illegible]	8315
Nurses' cap markings	
Nurses' capes	841
Nurses' dresses	8410
Nursery stock	8730
Nuts	
adjusting, differential, vehicular	2520
aircraft propeller hub	161
assembled washer	
[illegible]	5310
ball seat, hexagon	5310
battery, electrode	6140
blind rivet	5310
Brazil, shelled	8925
[illegible]	
cap, self-locking	
cashew, shelled	892
cashew, unshelled	8925
castellated, hexagon	5310
castellated, octagon	
[illegible]	
[illegible]	5310
check	5310
concave, hexagon	5310
concave, square	5310
cone seat, hexagon	5310
coupling, electrical conduit	5975
coupling, flexible casing, multiapplication	3040
double ball seat, hexagon	5310
drop bolt	5310
extended washer, double hexagon	5310
extended washer, hexagon	5310
extended washer, square	5310
eye	5310
fin lock, bomb	1325
fingerboard, musical instrument	7720
hexagon, jam	5310
hickory, shelled	8925
hickory, unshelled	8925
hose coupling	4730

342

211.78

Figure 4-5.—Cataloging Handbook H 2-2—Description to National Supply Classification (NSC).

in all new maintenance and supply publications; however, some of the older aircraft publications still contain the Navy coding sytem. So, once again, it is imperative that you be thoroughly familiar with the coding system in the publications you are using.

The SM&R codes are five position codes used to identify the source of spares, repair parts, and items of support equipment and the levels of maintenance authorized to use, maintain, overhaul, or condemn them.

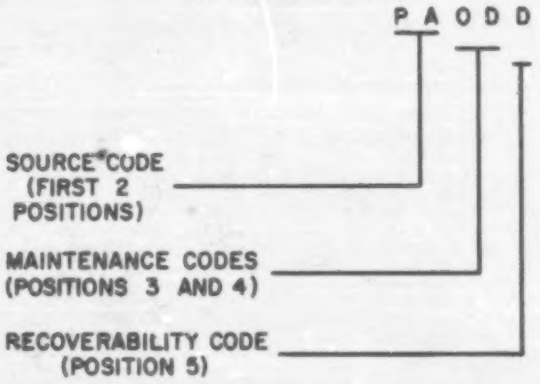
Figure 4-6 shows the component parts of the Joint Service Uniform SM&R code. The following paragraphs list these codes.

The first and second positions of the SM&R code indicates the source of the item, e.g., procured, manufactured, or assembled. Some are listed here.

PA — Item procured and stocked for anticipated or known usage that will not deteriorate (spoils, rusts, or rots).

PB — Item procured and stocked for insurance purposes because it is necessary that a minimum quantity be available in the supply systems.

PC — Item procured and stocked and which otherwise would be coded PA except that it will deteriorate.


P A O D D
SOURCE CODE (FIRST 2 POSITIONS)
MAINTENANCE CODES (POSITIONS 3 AND 4)
RECOVERABILITY CODE (POSITION 5)

206.272

Figure 4-6.—Component Part of Joint Service Uniform Source, Maintenance, and Recoverability Code (SM&R).

PD — Support item, excluding support equipment, procured for initial issue or outfitting and stocked only for subsequent or additional initial issues or outfittings. Not subject to automatic replenishment (re-supply).

PE — Support equipment procured and stocked for initial issue or outfitting to specified maintenance repair activities.

PF — Support equipment which is not stocked but will be centrally procured on demand.

PG — Item procured and stocked to provide for sustained support for the life of the equipment. (The use of this code has limited application in the Navy.)

KD — An item of a depot overhaul/repair kit and not purchased separately.

KF — An item of a maintenance kit and not purchased separately. (Replaced at organizational or intermediate levels.)

KB — Item included in both a depot overhaul repair kit and a maintenance kit.

MO — Item to be manufactured or fabricated at an organizational level.

MF — Item to be manufactured or fabricated at intermediate levels afloat.

MH — Item to be manufactured or fabricated at intermediate levels ashore.

MG — Item to be manufactured or fabricated at both afloat and ashore intermediate levels.

MD — Item to be manufactured or fabricated at a depot level.

AO — Item to be assembled at an organizational level.

AF — Item to be assembled at an intermediate level afloat.

AH — Item to be assembled at an intermediate level ashore.

AG — Item to be assembled at both afloat and ashore intermediate levels.

AD — Item to be assembled at a depot level.

XA — Item is not procured or stocked because the requirements for the item results in replacement of the next higher assembly.

XB — Item not stocked. If not available through salvage, requisition. (May result in direction to procure locally.)

XC — Installation drawing, diagram, instruction sheet, field service drawing, that is identified by manufacturer's part number and not stocked in the supply system.

Maintenance Code

Maintenance codes (as shown in fig. 4-6) are assigned to the levels of maintenance authorized to USE and REPAIR support items. The maintenance codes are entered in the third and fourth positions of the Joint Service SM&R code as follows:

Third Position	Removed, replaced, and used at
O	Organization level
F	Intermediate level afloat
G	Intermediate levels afloat and ashore
H	Intermediate level ashore
D	Aviation rework, Avionics and Ordnance Facilities, and Shipyards
L	Designated specialized repair activities
Z	Not authorized to be removed or replaced at any level

Fourth Position	Lowest maintenance level for complete repair
O	Organizational
F	Intermediate level afloat
H	Intermediate level ashore
G	Intermediate levels afloat and ashore
D	Depot level
L	Specialized repair activity
Z	Nonrepairable
B	No repair is authorized. (May be reconditioned by adjusting, lubricating, etc., at the user level.)

Recoverability Codes

Recoverability codes (as shown in fig. 4-6) are examples of items for disposing unserviceable items. They are entered in the fifth position of the Joint Service SM&R code as follows:

Code	Definition
Z	Nonrepairable item: Condemn and dispose of at the level indicated in column 3.
O	Repairable item: Condemn and dispose of at organizational level.
F	Repairable item: Condemn and dispose of at intermediate level afloat.
H	Repairable item: Condemn and dispose of at intermediate levels ashore.
G	Repairable item: Condemn and dispose of at intermediate levels afloat and ashore.
D	Repairable item: Condemn and dispose of at depot level.
L	Repairable item: Condemn and dispose of at depot or specialized repair activity.
A	Item requires special handling or condemnation procedures (precious metal, high dollar value, critical or hazardous material).

PARTS KIT CODES

Supporting items and material for the maintenance, repair, and rework of selected aeronautical repairable items are procured, stocked, requisitioned, accounted for, and used on a kit basis. Parts kits are processed using certain terms or definitions. The term, parts kit, should not be confused with the term, changes kit, which is procured and issued to perform a one-time modification of an item. Parts kits codes are described in the next paragraphs.

C Kit—Cure Data Component Kits

The letter, C, is applied to kits that contain cure-dated items such as diaphragms, packings, and O-rings. C kits also contain soft goods not subjected to age controls, such as gaskets, seals, and metallic items, i.e., screws, nuts, and washers. Any metallic item placed in the C kit is not duplicated in the D kits. Also, the range of cure-dated items does not exceed three months. The age of C kits is in calendar quarters. When cure-dated kits become overage due to the expiration of the storage period, the kit is disposed of as excess material.

D Kit—Overhaul Kit

The letter, D, is applied to kits that provide hardware repair parts required at the time of overhaul and that are available only to activities authorized to perform major overhauls. D kits do not contain cure-dated items.

F Kit—Fleet Kit

The letter, F, is applied to kits that provide items to be replaced at the organizational level of maintenance and that are available to activities authorized to perform organizational or higher level repair including major repair activities in support of fleet maintenance. Replacement of F kit parts normally does not require special tools or equipment. F kits do not contain cure-dated items.

PREEXPENDED BINS

Fast moving, consumable items, such as spark plugs, thermostats, gauges, nuts, belts, and washers with a unit cost of $25.00 or less may be preexpended. This material is paid for in advance and placed in bins. This material is available to the worker as needed. Items having a unit cost exceeding $25.00 may be preexpended with the approval of the commanding officer. In either case, the inventory at any one outlet must not exceed an estimated 30-day supply.

Specific items added to or deleted from the bins are determined jointly by the Supply Officer and the Maintenance Officer having cognizance over the shop in which such bins are located.

The quantity of each item preexpended is determined by the Supply Officer based on usage data or expected demands.

Preexpended bins are located in the maintenance area. However, the Supply Officer is primarily responsible for proper management and maintenance of the bins, including display, labeling, and initiating replenishment, when required.

The supply department inventories the bins a minimum of twice a week in order to determine replenishment actions, and corrects any placement of items which have gotten into the wrong bins.

MATERIAL TURN-IN

There are two main reasons for turning-in material—the first and most common is the turning in of a damaged, wornout, or otherwise inoperative part in exchange for the same or replacement RFI item; and second, returning material for credit, such as excess material or material received in error.

When it is determined that a needed part is an exchange item, the old part should be cleaned of grease and dirt, drained, flushed, or purged, as necessary, before turning it in. It is your responsibility to attach equipment condition tags directly to the repairable item. An equipment condition label is applied to the exterior of the container. All turn-in material should be returned, if practicable, in the container in which the new item was received.

Activities placing items into shipping containers are responsible for accurate and complete information on the tag and the label, including the necessary removal or covering over of previous markings on the container which no longer apply. The primary reason for the tags and labels is to identify the material and its condition without disturbing the contents. These tags and labels indicate the required disposition to those processing the material through channels.

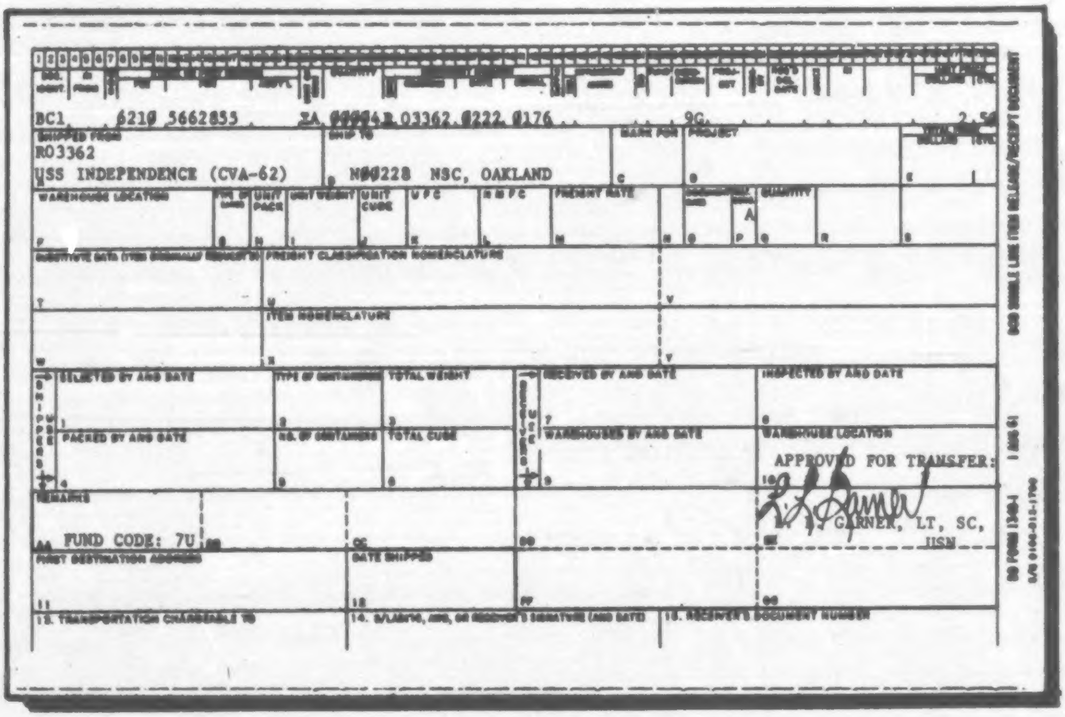
When a defective repairable item is turned in, the following forms are required: a five part VIDS/MAF and the Accessory and Component Service Record, when applicable. The supply department uses copy two of the VIDS/MAF for bookkeeping purposes. Copies one, three, four, and five of the VIDS/MAF stay with the item to the intermediate maintenance activity. When repair is completed by the AIMD, copy four of the VIDS/MAF is attached to the RFI item and the item is returned to the supply system.

If material being turned in is no longer required and is RFI, a Single Line Item Release/Receipt Document, DD Form 1348-1, as shown in figure 4-7 is submitted with the item. RFI means "ready for issue" in all respects, i.e., preservation still intact and item in original or reusable container with seals unbroken.

Administrative Screening Unit (AIMD)

Components that are turned into the AIMD material control area are processed through the administrative screening unit to determine whether the item is within the check/test/repair capability of the AIMD, and whether such check/test/repair action is desirable.

When work on components which have been processed and inducted into the AIMD has been completed, the component is returned to



BC1 6210 5662855 2A 00004 R 03362 0222 0176 9G 2.5

SHIPPED FROM: R03362 USS INDEPENDENCE (CVA-62)

SHIP TO: N00228 NSC, OAKLAND

MARK FOR

PROJECT

WAREHOUSE LOCATION

UNIT PACK

UNIT WEIGHT

UNIT CUBE

UFC

SMFC

FREIGHT RATE

QUANTITY

A

FREIGHT CLASSIFICATION NOMENCLATURE

ITEM NOMENCLATURE

SELECTED BY AND DATE

TOTAL WEIGHT

RECEIVED BY AND DATE

INSPECTED BY AND DATE

PACKED BY AND DATE

TOTAL CUBE

WAREHOUSED BY AND DATE

WAREHOUSE LOCATION

APPROVED FOR TRANSFER:

L. L. Garner

GARNER, LT, SC, USN

REMARKS

FUND CODE: 7U

DATE SHIPPED

211.228

Figure 4-7.—Single Line Item Release/Receipt (Turn-In) Document.

material control who, in turn, notifies the SSC that the component is ready for pickup and return to the pool or supply stock, as applicable.

Servmart Support

SERMARTs are operated to provide a retail outlet for nontechnical supplies used for administrative and housekeeping purposes. The use of a SERVMART helps the supporting activity (IMA) as well as supported operating activities (OMA). The ability to requisition/pay for many items with one request document reduces paperwork and speeds material issue.

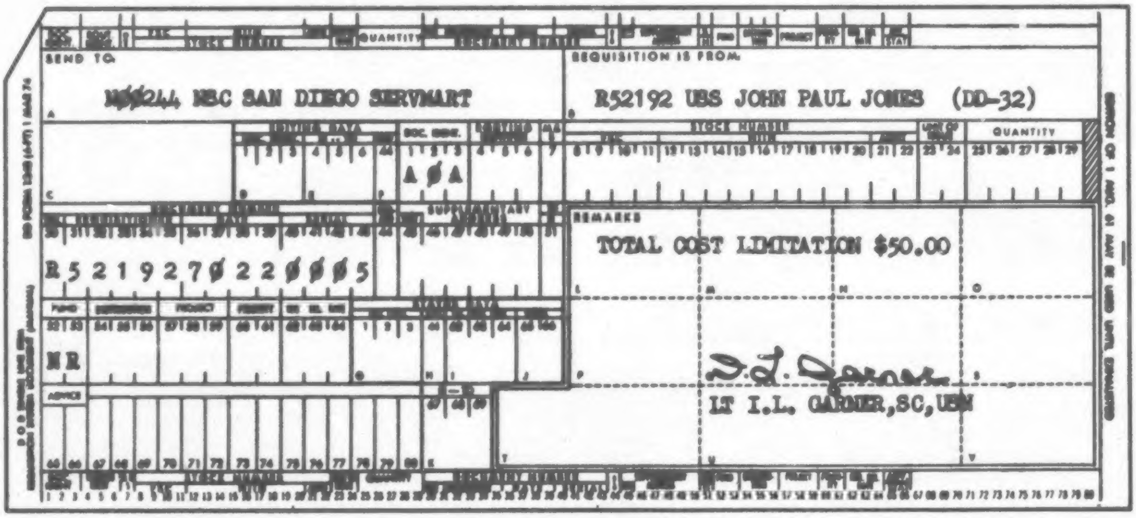
Figure 4-8 illustrates a typical SERVMART requisition. Examples of items carried in SERVMART are hand tools, corrosion preventative material, and petroleum, oils, and lubricants. SERVMART requisitions carry a stated dollar limit to preserve accounting control and help prevent theft.

SUPPLY DISCIPLINE

One of your major responsibilities is supply discipline which, under operating conditions at sea can sometimes be difficult. However, the impact of sophisticated weapons and high cost will require a special effort in material management in order to keep the cost of maintenance as low as possible while maintaining a high state of readiness.

You contribute to material management by ensuring that (1) only necessary and proper replacement components are ordered, (2) new components are installed as soon as possible after receipt, and (3) the defective components are turned in for repair to the supply system as soon as possible. You can manage material best by making sure that the repair of all components is kept at the lowest level of maintenance, and returning promptly the RFI component to the supply system.

When ordering components, you should not overemphasize the urgency-of-need in order to get maintenance control to assign a higher priority than is actually necessary. Abuse of the priority system reduces the effort of the supply system and wastes time which can be put to better use.



SEND TO: N00244 NSC SAN DIEGO SERVMART

REQUISITION IS FROM: R52192 USS JOHN PAUL JONES (DD-32)

DOC. IDENT.: A 0 A

R 5 2 1 9 2 7 0 2 2 0 0 0 5

N R

REMARKS: TOTAL COST LIMITATION $50.00

I.L. Garner
LT I.L. GARNER,SC,USN

43.24

Figure 4-8.—SERVMART Request.

By conscientious effort on your part and of all supply personnel, cost effectiveness and combat readiness can be maintained at desirable levels.

Material in excess of allowance or departmental need should be returned promptly to the supply department. Every attempt should be made to return such material in a ready-for-issue condition.

Material returned to supply is documented on DD Form 1348-1, and in some cases, DD Form 1149.

SUMMARY

Supply is a complex matter in the Navy. It pays to keep abreast of everything going on with respect to changes in the supply system, or in the methods for requisitioning materials. The treatment here has been brief by necessity, but it should have given you some insight into supply. The station instructions with regard to supply are important; study these well as you go from station to station. Although the Navy operates on a uniform system, there are minor variations, and knowing these will make the difference between smooth operations or a headache.

CHAPTER 5

GSE TRAINING

You, as a petty officer, will be frequently called upon to conduct training. The training of personnel is a necessary function which is all too often avoided. How many times have you been expected to do a task without any experience, training, or even a simple briefing as to how to do it? You probably completed the task through "trial and error," a most inefficient and sometimes unsafe way of doing any job. If you had received the proper training, then time and material would have been saved and a better job done.

Since at some time you may have been exposed to rather sketchy training, it is the intent of this chapter to stress the importance of your new role in training. As a petty officer, you are aware that the training you received must be improved upon and that the mistakes made in your training must not be repeated.

Training of subordinates is the most important responsibility of a petty officer. A second or third class petty officer has regular and continuing responsibilities for the training of others. Even though you may be fortunate enough to have a trainee who is highly skilled and well trained, some training is still needed. For example, the training of strikers and lower rated personnel for advancement-in-rate is a continuing, never-ending process. Under the Navy rotation policy the best personnel are transferred eventually and replacements will, in most instances, require additional training before new personnel can be relied upon to take their places as effective team members of the work center organization. You may be designated the training petty officer for your work center and your ability to conduct an effective overall training program for assigned personnel is most desirable.

However, before you can be designated as a training petty officer you must meet the training requirements for Petty Officers 3 & 2. A training requirement for advancement from airman to third class petty officer and nonrated personnel is satisfactory completion of the correspondence course based on the text *Military Requirements for Petty Officer 3 & 2,* NAVEDTRA 10056 (latest edition). This course sets forth the basic principles of training, in general, and teaching techniques in particular. Continued study of this course and experience as a third class petty officer may eventually lead to your advancement to second class petty officer.

An advancement and training requirement for second class petty officer to first class petty officer is the satisfactory completion of the correspondence course based on *Military Requirements for Petty Officer First Class and Chief,* NAVEDTRA 10057 (latest edition). This manual expands and amplifies training theory and introduces job analysis, training aids, and testing. Probably for the first time in the Aviation Support Equipment Technician's career, the prospective first class technician is required to demonstrate correct instructional techniques.

ORGANIZING A TRAINING PROGRAM

Organizing a training program involves such things as: planning lessons, developing job plans, selecting and qualifying instructors, making arrangements for classroom space, coordinating the training program with the scheduled maintenance workload, procuring visual and other training aids, and determining teaching methods for each lesson or lesson series.

92

The subject matter areas to be included in the training program are: (1) material relating to the maintenance of GSE supported equipment, (2) general material required by personnel for advancement-in-rating examinations, (3) materials relative to examinations, and (4) GSE licensing programs. In most cases, lessons may fall under more than one of these broad subject areas.

Once it has been determined what publications adequately cover the subject areas, the material must be divided into lessons. Of course, it is helpful to assign numbers to the lessons and initiate personnel training progress records for each individual. These records should provide a handy index as to the state of training of the work center personnel.

The state of training and experience of the assigned third or second class petty officers, in part, determines who teaches each lesson. You, your fellow petty officers, or your supervisor may actually teach the lesson. Other factors such as the locale, the work assignments, or the instructors available may affect the scheduling of instructors.

If at all possible, training sessions should be conducted at the same time each day and on a regular schedule. In order to have a regular period for training, it is necessary to coordinate the training periods with scheduled maintenance, meal hours, watches, and availability of classrooms.

Some subjects are better suited for a given type of instructional technique than are others. The type of presentation for each lesson should be planned in advance. This will allow you to select the best instructional technique, i.e., what method to use, classroom, OJT, etc., and also the best way to rotate the lessons among other instructors so that they can get experience under different instructional methods.

The effectiveness of GSE training can be greatly enhanced by the use of training aids. You should always be on the alert for scrap material or components that can be converted into training aids at minimum expense. Check NAVAIR 10-10-777 for applicable training films and, if available, schedule them for showing with specific lessons.

When planning a training program, you should consider where the classroom sessions should be conducted. The space selected should be in a quiet area or at least one with a minimum amount of noise. The area should be well lighted and large enough to accommodate the students. Adequate ventilation helps keep the class awake and more comfortable. Convenience is another factor in the selection of the classroom space. Some of the desirable space characteristics may, on occasion, have to be sacrificed in order to find a classroom nearer to the working area.

TRAINING FORMS AND CONCEPTS

Training is generally conducted in one of two types of environments—either formal or informal.

FORMAL TRAINING

This type of training is conducted in the classroom through lectures and discussions, supplemented by research and study and applicable visual aids. A schedule of formal training is normally prepared and published periodically by your maintenance administration officer. The list usually includes the time for training, the subject of the lesson, location of the classroom, and the name of the instructor.

When you are first assigned as an instructor, your lesson guides are usually prepared by your supervisor or a first class petty officer who is qualified as an instructor in the subject matter. These lesson guides indicate the titles, objectives, time to be consumed in presenting each lesson, list of instructional aids, list of references, outline for presentation, and a summary of each lesson of the series.

When you have been assigned to instruct a given lesson, it is your responsibility to get a copy of the lesson guide and from it prepare your lesson plan. Lesson plans are prepared by each individual instructor based on the lesson guide. While lesson plans may differ from instructor to instructor, they must adequately cover the subject. Additional information on formal training is covered in *Military Requirements for Petty Officers 3 & 2,* NAVEDTRA 10056 (latest edition).

INFORMAL TRAINING

Informal training is usually on-the-job (OJT) training. It is a planned program designated to qualify personnel, through self-study and supervised instruction and demonstration of proper performance. OJT is conducted in your actual work situation by petty officers within your work center who are qualified AS technicians and know the job thoroughly in their support of the work center's mission. Although the responsibility for conducting OJT is delegated to specific individuals, the overall OJT program must be of concern to every petty officer in your work center. The nature and effectiveness of the training conducted in your work center today largely determines the quality of the work produced by the work center tomorrow.

The concept of OJT is based on the premise that, in career development, certain skills and knowledges must be obtained before trainees can progress in their chosen career fields. OJT also provides the versatility needed by the trainee to move quickly from one kind of equipment or system to another. The trainee acquires job knowledge by self-study of the rate training manuals with professional training acquired by performing on-the-job training under the supervision of a skilled worker.

Knowledge Development

This phase of OJT is administered through the use of rate training manuals (RTMs). RTMs contain information on common knowledge requirement for each rating. Information on a specific item of equipment is included in the RTM only when that item is used throughout the text, or when equipment information is necessary to illustrate the application of a principle. The subject matter included in all RTMs is based upon the knowledge elements listed in the approved *Personnel Qualifications Standard,* NAVPERS 18068 (latest edition) for your rating, the first page of which is shown in figure 5-1 in order to provide you with a sample of the standards.

Professional Training

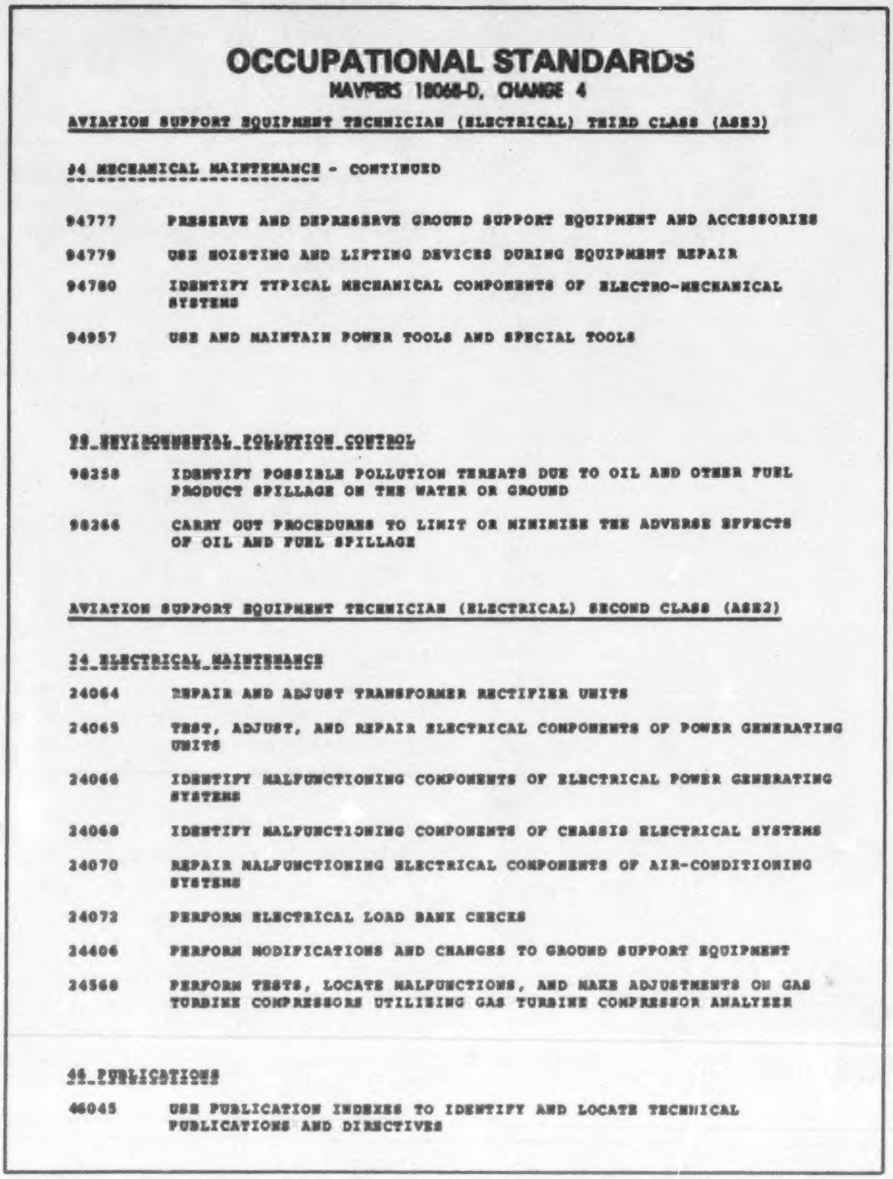
Professional training is normally conducted within the work center to which you are assigned. The responsibility for conducting the professional training phase of OJT is a responsibility of each supervisor in the work center who directs or controls the work of the people in his charge. Professional training is the practical application of job knowledge. It places you in an operational situation where the performance of specific training tasks are a part of your duty assignments. After you acquire a skill in the simpler tasks, then you are assigned other tasks that are progressively more complex.

Therefore, you are constantly broadening your base of skills and knowledges until you should be proficient in all elements of your job. During this training period, the organization receives the benefits of the trainees production while the trainees benefit is the learning. Learning results from the close work association between the trainee and the trainer.

MAINTENANCE TRAINING

Specialized skills are required to maintain and operate present day ground support equipment (GSE) and its associated equipment. The training programs of particular interest to the Aviation Support Equipment Technician are Navy training schools and factory training. These programs are outlined in the following discussion and also in OPNAVINST 1500.11 (Series).

The Aviation Support Equipment Technician Class "A" schools for ASM and ASE trainees are located at the Naval Air Technical Training Command (NATTC), Memphis, Tennessee. Class "A" schools provide the basic technical knowledge and skills required to prepare for job entry level performance and some further specialized training, such as apprenticeship training.



OCCUPATIONAL STANDARDS

NAVPERS 18068-D, CHANGE 4

AVIATION SUPPORT EQUIPMENT TECHNICIAN (ELECTRICAL) THIRD CLASS (ASE3)

94 MECHANICAL MAINTENANCE - CONTINUED

94777	PRESERVE AND DEPRESERVE GROUND SUPPORT EQUIPMENT AND ACCESSORIES
94779	USE HOISTING AND LIFTING DEVICES DURING EQUIPMENT REPAIR
94780	IDENTIFY TYPICAL MECHANICAL COMPONENTS OF ELECTRO-MECHANICAL SYSTEMS
94957	USE AND MAINTAIN POWER TOOLS AND SPECIAL TOOLS

98_ENVIRONMENTAL_POLLUTION_CONTROL

98258	IDENTIFY POSSIBLE POLLUTION THREATS DUE TO OIL AND OTHER FUEL PRODUCT SPILLAGE ON THE WATER OR GROUND
98266	CARRY OUT PROCEDURES TO LIMIT OR MINIMIZE THE ADVERSE EFFECTS OF OIL AND FUEL SPILLAGE

AVIATION SUPPORT EQUIPMENT TECHNICIAN (ELECTRICAL) SECOND CLASS (ASE2)

24_ELECTRICAL_MAINTENANCE

24064	REPAIR AND ADJUST TRANSFORMER RECTIFIER UNITS
24065	TEST, ADJUST, AND REPAIR ELECTRICAL COMPONENTS OF POWER GENERATING UNITS
24066	IDENTIFY MALFUNCTIONING COMPONENTS OF ELECTRICAL POWER GENERATING SYSTEMS
24068	IDENTIFY MALFUNCTIONING COMPONENTS OF CHASSIS ELECTRICAL SYSTEMS
24070	REPAIR MALFUNCTIONING ELECTRICAL COMPONENTS OF AIR-CONDITIONING SYSTEMS
24072	PERFORM ELECTRICAL LOAD BANK CHECKS
24406	PERFORM MODIFICATIONS AND CHANGES TO GROUND SUPPORT EQUIPMENT
24568	PERFORM TESTS, LOCATE MALFUNCTIONS, AND MAKE ADJUSTMENTS ON GAS TURBINE COMPRESSORS UTILIZING GAS TURBINE COMPRESSOR ANALYZER

46_PUBLICATIONS

46045	USE PUBLICATION INDEXES TO IDENTIFY AND LOCATE TECHNICAL PUBLICATIONS AND DIRECTIVES

Figure 5-1.—Occupational standards.

The Naval Air Maintenance Training Group (NAMTRAGRU) located in Jacksonville, Florida, and North Island, California, provide Class "C" school training on specific types of ground support equipment. These schools enable the AS technician to acquire advanced knowledge, skills, and techniques needed to perform a particular job on a specific type of equipment, such as NC8, NR5C, MD3, and GTCP-100 gas turbine engines.

Each Naval Air Rework Facility (NARF) provides specialized on-the-job training with emphasis on troubleshooting, alignment, and benchwork covering various accessories and components. This training is not intended to duplicate any present courses of instruction provided by the NAMTRADETs, but is intended to supplement other training courses. These courses are tailored to the operational requirements of the fleet and the training commands and are listed in the *Catalog of Navy Training Courses,* NAVEDTRA 10500, Volumes I, II, and III.

GSE OPERATOR TRAINING PROGRAM

As an Aviation Support Equipment Technician 3 or 2, you will need to become familiar with the procedures necessary to train and qualify personnel in the operation and maintenance of GSE. This type training is required before a person can be licensed to operate and maintain or service GSE. The training and licensing program is a command responsibility of AIMDs ashore and afloat, and is normally a direct responsibility of your work center supervisor.

During recent years the improper use of GSE has resulted in many ground handling accidents. This improper use has caused excessive repair and replacement costs amounting to millions of dollars annually and reduced operational readiness, plus the hardships that always accompany personnel injuries.

Investigations have shown the major factor in the improper use of GSE to be a lack of effective training for operators and maintenance technicians. As a result of these investigations, the Chief of Naval Operations has initiated a GSE Training Program. The objectives of this program, OPNAVINST 4790.2 (Series), is to improve safety, provide training for licensing operators, and improve GSE readiness.

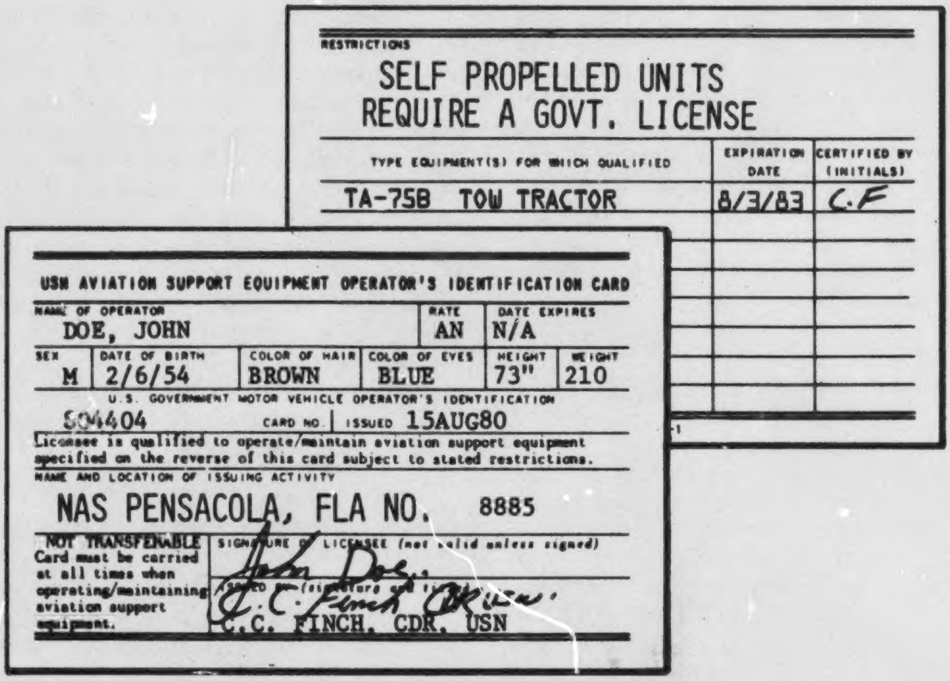
GSE TRAINING MATERIAL

The GSE materials distributed by NAMTRAGRU to the Intermediate maintenance activities are serialized, accountable, and charged to the activity having custody. This material must be kept in a state of readiness at all times. The training courses contain all the materials necessary for a training situation and also the performance standards required for both written tests and practical operation. As new training material and license performance standards on additional or new GSE are completed and approved, they are distributed by NAMTRAGRU. In every case, local maintenance personnel must be licensed under the approved standards within 90 days following introduction of the training materials at the local level. Licensing under the standards is accomplished by issuing a GSE operator license. If NAMTRAGRU-furnished training materials are not available on certain GSE, the support activity should develop it's own training according to acceptable standards of learning.

LICENSING PROCEDURES FOR GSE

All personnel operating automotive GSE driven as a vehicle must have a valid Government Motor Vehicle Operators Card and a GSE operators license. On all other GSE which is not self-propelled, operators must have a valid GSE operators license only. The GSE operators license OPNAV Form 4790/102 as shown in figure 5-2 is mandatory for all equipment for which standardized training is available.

GSE operator licenses are valid for a 3-year period from the certified date of qualification for each type equipment, unless revoked. The expiration is noted in the expiration date column on the reverse side of the GSE operator's license. If more than one type of equipment is licensed on the same card the date of expiration is the one that reaches the 3-year limit first. When a license expires or is revoked the operator must requalify before the license is reissued. Requalification consists of passing both the written and performance tests used for the initial licensing. Failure to qualify as an operator requires that the course of instruction for the equipment be repeated. Renewal of licenses is for a 3-year period for that specific equipment only. All other GSE listed on the same license may also require that the operator must operate that equipment to requalify. When a GSE operator is transferred to



RESTRICTIONS
SELF PROPELLED UNITS
REQUIRE A GOVT. LICENSE

TYPE EQUIPMENT(S) FOR WHICH QUALIFIED	EXPIRATION DATE	CERTIFIED BY (INITIALS)
TA-75B TOW TRACTOR	8/3/83	C.F

USN AVIATION SUPPORT EQUIPMENT OPERATOR'S IDENTIFICATION CARD

NAME OF OPERATOR	RATE	DATE EXPIRES
DOE, JOHN	AN	N/A

SEX	DATE OF BIRTH	COLOR OF HAIR	COLOR OF EYES	HEIGHT	WEIGHT
M	2/6/54	BROWN	BLUE	73"	210

U.S. GOVERNMENT MOTOR VEHICLE OPERATOR'S IDENTIFICATION
504404 CARD NO. | ISSUED 15AUG80

Licensee is qualified to operate/maintain aviation support equipment specified on the reverse of this card subject to stated restrictions.

NAME AND LOCATION OF ISSUING ACTIVITY
NAS PENSACOLA, FLA NO. 8885

NOT TRANSFERABLE
Card must be carried at all times when operating/maintaining aviation support equipment.

SIGNATURE OF LICENSEE (not valid unless signed)
John Doe.
SIGNED BY (signature and title)
C.C. Finch CDR
C.C. FINCH, CDR, USN

Figure 5-2.—GSE operator's license OPNAV 4790/102.

another command, the operator's license becomes invalid and the operator must requalify on the equipment of the new command.

ELIGIBILITY FOR GSE TRAINING

If you are selected for training on driven (self-propelled automotive type) equipment you must have a Government Motor Vehicle Operators Card (SF-46).

You can also receive instructor training, locally, if you are assigned to a support activity whether on an air station, facility, or on a ship. Usually, you, as an AS, will get trained so that you can train others. If there is a shortage of AS people, people from any other rating, may be trained. Persons selected for this training should be mature, possess sound judgement, be conscientious, and have traits required of good instructors. Some of these traits have been included here. They are:

1. Pass a test for depth perception.
2. Are screened to eliminate those persons who have shown a tendency to be accident prone.
3. Have the degree of maturity and judgement equal to that required for safe operation and care of the GSE.
4. Possess a valid Government Motor Vehicle Operators Card (SF-46) prior to training on self-propelled type GSE.

GSE OPERATORS LICENSES

GSE operators license (OPNAV Form 4790/102) is to be issued only when a certificate or letter of satisfactory completion of GSE training course is provided by the operator and is restricted to those pieces of GSE on which standardized training has been received.

EQUIPMENT LICENSES FOR WHICH REQUIREMENTS ARE NOT SPECIFIED

Operators of GSE for which standardized training materials are not available must have an operator's license which is valid at the local level. The AIMD is responsible for providing GSE operator training on GSE whether standardized training material is available or not. GSE for which standardized training is not available cannot be licensed by the use of the GSE operators license (OPNAV Form 4790/102). Local training licensing requirements, and forms remain effective locally until they are superseded by the issuance of a standard training and licensing requirement.

REVOCATION OF LICENSES

Commanding officers and officers in charge are not only charged with the responsibility of issuing GSE operator licenses but they can also revoke them with sufficient cause.

REQUIRED READING

Certain directives and publications, as directed by your aircraft maintenance officer, are routed for dissemination as "maintenance information" to your work center. This material is incorporated on the "standing required reading board" located in your work center. The board displays maintenance information and such other information which are important to your division and could be of special interest to you.

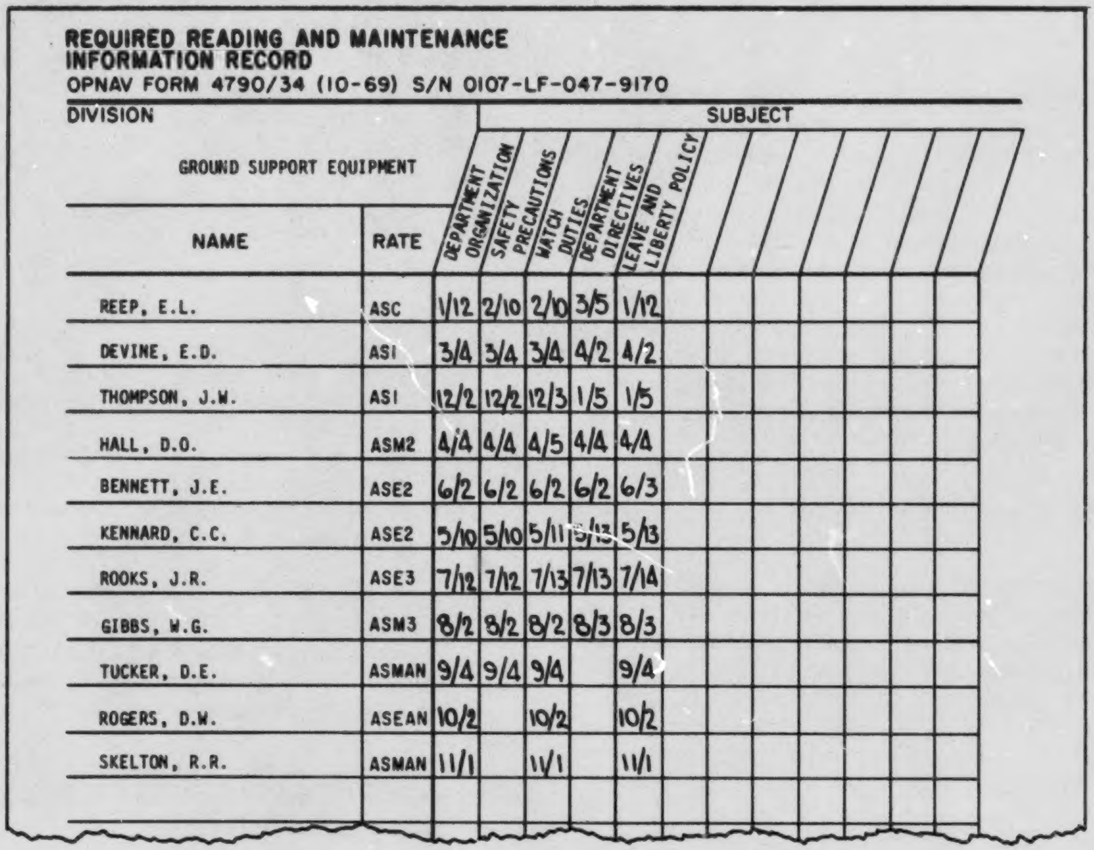
A standing file is kept by your division which contains material removed from the required reading board that has been read and initialed by all assigned personnel, and is later filed for the indoctrination of new personnel. The required reading and maintenance information record, OPNAV Form 4790/34 (figure 5-3), is used to maintain records of required reading by division personnel. The required reading board is an integral part of training.

TRAINING FOLDER

The training folder is a standard 9" x 12" folder initiated and maintained on each person within the work center. The training folder is a consolidated account of a person's military and professional training. It has four individual sections which are on the right-hand side and are separated as follows:

1. Training Record Information Sheet (local).
2. General Military Training Syllabus (OPNAV Form 4790/33).
3. Professional Training Syllabus (OPNAV Form 4790/33).
4. Informal/on-the-job training record (OPNAV Form 4790/33, or PQS Qualification cards where applicable).

The training folder is a record of accomplishments which document the entire range of the trainee's progression from E-1 through E-9. It is normally kept in the work center. However, it could also be kept in a centralized location within your department. When you are transferred, your training record will go with you to your next duty command.



REQUIRED READING AND MAINTENANCE INFORMATION RECORD
OPNAV FORM 4790/34 (10-69) S/N 0107-LF-047-9170

DIVISION		SUBJECT											
GROUND SUPPORT EQUIPMENT		DEPARTMENT ORGANIZATION	SAFETY PRECAUTIONS	WATCH DUTIES	DEPARTMENT DIRECTIVES	LEAVE AND LIBERTY POLICY							
NAME	RATE												
REEP, E.L.	ASC	1/12	2/10	2/10	3/5	1/12							
DEVINE, E.D.	ASI	3/4	3/4	3/4	4/2	4/2							
THOMPSON, J.W.	ASI	12/2	12/2	12/3	1/5	1/5							
HALL, D.O.	ASM2	4/4	4/4	4/5	4/4	4/4							
BENNETT, J.E.	ASE2	6/2	6/2	6/2	6/2	6/3							
KENNARD, C.C.	ASE2	5/10	5/10	5/11	5/13	5/13							
ROOKS, J.R.	ASE3	7/12	7/12	7/13	7/13	7/14							
GIBBS, W.G.	ASM3	8/2	8/2	8/2	8/3	8/3							
TUCKER, D.E.	ASMAN	9/4	9/4	9/4		9/4							
ROGERS, D.W.	ASEAN	10/2		10/2		10/2							
SKELTON, R.R.	ASMAN	11/1		11/1		11/1							

Figure 5-3.—Required reading form.

99

CHAPTER 6

GROUND SUPPORT EQUIPMENT

Ground support equipment has become as important to the assigned mission of naval aviation activities as the aircraft itself. Many different types of support equipment are required for handling, servicing, loading, testing, and maintaining aircraft. Because most of this equipment is used in direct support of the aircraft itself, aircraft squadrons and the Air Department aboard carriers are the principal users of ground support equipment. Within this department, personnel of the flight deck and hangar deck aircraft handling crews use aircraft handling equipment such as tow tractors and spotting dollies. In addition, personnel of the Aircraft Crash, Fire, and Rescue crews use such equipment as the MB-5 aircraft firefighting and rescue trucks. These users depend upon personnel of the Aviation Support Equipment Technician rating (AS), who are normally assigned to intermediate maintenance activities, for the maintenance of this equipment.

Since the above activities are the principal users, the equipment is usually operated by personnel of ratings other than AS. In addition, servicing and preoperational inspections are frequently accomplished by personnel of these using activities. Thus, personnel in the AS rating are concerned primarily with major inspections and repair. However, this does not mean that you are relieved of all responsibilities concerning the operation and servicing of the equipment. To effectively perform all phases of maintenance—inspecting, troubleshooting, repairing, testing, etc.—you must understand thoroughly the operation of the equipment. This is especially important when troubleshooting malfunctions and testing equipment.

In addition, you may frequently check out squadron personnel in the operation and servicing of certain types of equipment. Several types of support equipment require licensed operators. The training, testing, and licensing of these operators are also responsibilities of personnel in the Aviation Support Equipment Technician rating.

Common types of ground support equipment are described in this chapter. It must be emphasized, however, that this is a training manual for support equipment in general and that the applicable Operation and Service Instructions for a specific item of equipment must be consulted for the correct and specific operating and servicing procedures.

TYPES OF GROUND SUPPORT EQUIPMENT

Ground Support Equipment (GSE), for the purpose of classifying maintenance functions, is defined in OPNAVINST 4790.2 (Series) as "all equipment required on the ground to make an aeronautical system, support system, subsystem, or end item of equipment (GSE for GSE) operational in its intended environment." This is primarily that equipment covered by the Aircraft Maintenance and Material Readiness (AMMRL) program.

GSE is categorized as common (general purpose) and peculiar (special purpose) and is further divided into the categories of Avionic GSE and Non-Avionic GSE.

AVIONICS GSE

Avionic GSE (common and peculiar) includes all equipment of an electronic nature used for the test, troubleshooting, alignment, or calibration of aircraft systems and components. Some examples of Avionics GSE are Automatic Test Equipment (ATE), Versatile Avionics Shop Test (VAST) and temperature and fuel quantity indicator test sets. Some of the test equipment such as multimeters that are used in the GSE shop are Avionic GSE and are maintained by the avionics shops.

NON-AVIONICS GSE

Non-Avionics GSE (common and peculiar) refers to all equipment that is nonelectronic in nature. It may be powered or nonpowered. Some examples of powered equipment are Mobile Electric Power Plants (NE-8A), gas turbine power service equipment (NCPP-105), aircraft tow tractors (TA-75) and hydraulic service units (AHT-64). Nonpowered equipment examples are aircraft jacks (B4A), aircraft tow bars (NT-4), aircraft slings, and maintenance work stands. The AS rate is responsible for maintaining the non-avionic GSE. An exception to this is installed equipment, such as Hydraulic Test Stands (HCT-10) and Electrical Test Units (VARI-DRIVES) that are maintained and documented by the work center having physical custody. The installed Jet Engine Test Facilities' maintenance responsibilities are assigned to the work center having physical custody (usually the power plants work center) along with the station's Public Works Department which is responsible for the structure and basic systems (such as fuel, air, and water).

The ordnance equipment is maintained by the Weapons Department and also the Public Works Department.

TOW TRACTORS AND AIRCRAFT SPOTTING DOLLIES

A tow tractor or aircraft spotting dolly is the only means of propulsion for the majority of aircraft on the ground with the engines not running. Most present day aircraft are too heavy and large to be moved by manpower alone. Tow tractors are also used for towing trailer-mounted support equipment.

Tow tractors must be especially maneuverable, particularly those used on aircraft carriers. Maneuverability of the tractor depends on its dimensions and turning radius. The smaller the size and turning radius, the more maneuverable the tractor. The type of transmission also contributes to the ease of handling the tractor. Modern tow tractors have automatic transmissions. Compared with the standard transmissions, the automatic transmission provides a smoother coupling from the engine to the driving wheels. It also frees the driver from operating a clutch and allows him to concentrate more on the job at hand. This results in smoother and safer movement of aircraft and equipment.

Tow tractors are often rated by drawbar pull. The drawbar pull is the amount of force that the tractor can exert on dry concrete. The drawbar pull of any tractor is dependent on the type and condition of the surface on which it is being used. Dry concrete gives the most traction; hence the most drawbar pull for a given tractor. On a wet, fuel-soaked steel deck there may be no traction.

Support equipment for supplying electric power and/or compressed air for aircraft engine starting or servicing is installed on some tractors.

Aircraft tow tractors are usually classified by one of two designations—the M series and the TA series. Some tractors may have both designations. In this chapter we describe the MRS-190 and MD-3 tow tractors. The first two letters of the M series do not have a standard meaning. The number in the M series is the model number. A letter following the model number indicates the number of modifications to that model tractor. An A indicates the first modification, a B indicates the second modification, etc. The TA in the TA series denotes Tractor, Aircraft. The numbers following the TA indicate the first two numbers of the drawbar pull. Other designations are sometimes used to identify tractors. One example is the JG-75 tow tractor. This tractor, however, is one model of the type TA-75 tow tractor. Another type of tractor to be discussed later is the A/S 32A-30 ground support equipment tractor, a tractor used to move equipment.

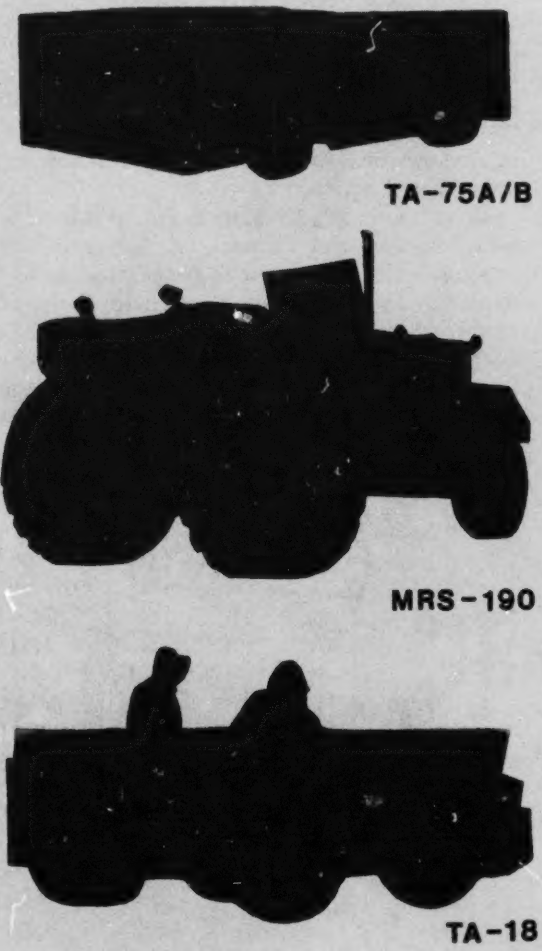
All tractors classified as a certain type are not always manufactured by the same contractor. As a result, the tractors may not be identical in all respects. They may differ in appearance. The instruments and controls may be arranged differently. Such major components as the engines and transmissions may be manufactured by different companies. However, these tractors are still classified as the same type as long as they meet the Military Specifications for that type. The same is true for many other types of support equipment. This is another important reason why you should consult the applicable technical publications to properly and safely operate, service, and maintain each specific item of support equipment.

As indicated by the preceding discussion, there are several types and models of tractors available to aviation activities. The tractors described in the following paragraphs are representative of the types most widely used at the present time.

TA-18 TOW TRACTOR

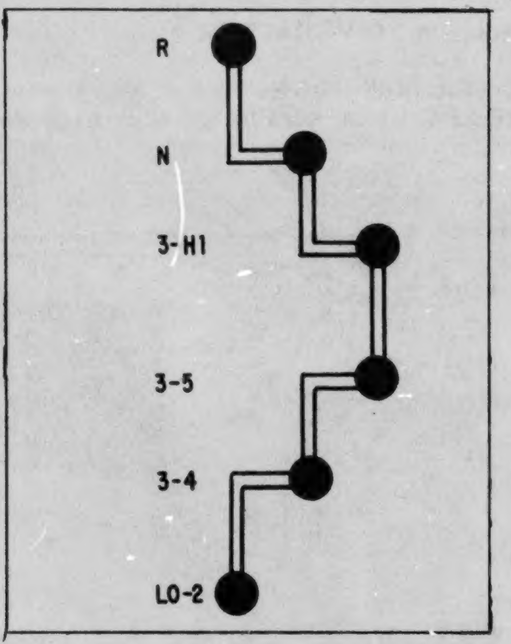
This is a gasoline powered tractor for use on shore bases as an aircraft towing and spotting vehicle for large aircraft. This tractor has a drawbar pull of 18,000 pounds.

The TA-18, shown in figure 6-1, has an automatic transmission with six forward speeds and one reverse speed. The speed ranges are selected by a shift lever located on top of the transmission cover. The transmission shift pattern is shown in figure 6-2. The tractor dimensions are 14 feet 10 inches long, 8 feet wide, and



227.85

Figure 6-1.—Tow tractors.



225.22

Figure 6-2.—TA-18 transmission shift pattern.

101

5 feet 7 inches high. The turning radius is 24 feet 10 inches. The gross weight of this tractor is 25,800 pounds. Normally, the driver's compartment is open, as shown in figure 6-1, but if the tractor is to be used in arctic weather, a completely enclosed cab is available. These cabs are equipped with windshield wipers, a heater, and a defroster.

TA-75A/B TOW TRACTOR

The TA-75A/B is a gasoline-powered tractor intended for use on shore bases as a towing and spotting vehicle for aircraft with gross weights up to 75,000 pounds.

The TA-75A/B (figure 6-1) has provisions for mounting a gas turbine compressor or other servicing equipment. This add-on provision has not been widely used. The tractor is equipped with an automatic transmission that has three forward speeds and one reverse speed. The tractor dimensions are 20'3" long, 5'6" wide, and 3'2" high. The turning radius is a minimum of 140".

MRS-190 TOW TRACTOR

The MRS-190 tow tractor, also shown in figure 6-1, is intended for use at air stations for positioning aircraft arresting gear. This tractor weighs 47,000 pounds and is capable of exerting sufficient drawbar pull to perform practically any work that may be required. It is 17 feet long and 9 feet 6 inches wide. It is powered by a 355-horsepower diesel engine and is equipped with a 5-speed standard transmission.

A/S 32A-30 AIRCRAFT GROUND SUPPORT EQUIPMENT TRACTOR

The A/S 32 tractor (figure 6-3) is designed to tow mobile ground support equipment such as starting units, work stands, electrical power plants, hydraulic test stands, and other GSE. It has a towing capacity of approximately 4,000-pound drawbar pull and can also be used to tow armament handling equipment. As a secondary mission, it can be used to tow light aircraft and helicopters.

The tractor is a gasoline engine-powered unit with a Chrysler model A-727 automatic transmission. It is a shore based tractor to be used on concrete or asphalt surfaces in support of aircraft operations. Hydraulic brakes are on both front and rear wheels and it has power assist steering. At the time of this writing there have been two separate contracts to manufacture the A/S 32 tractor.

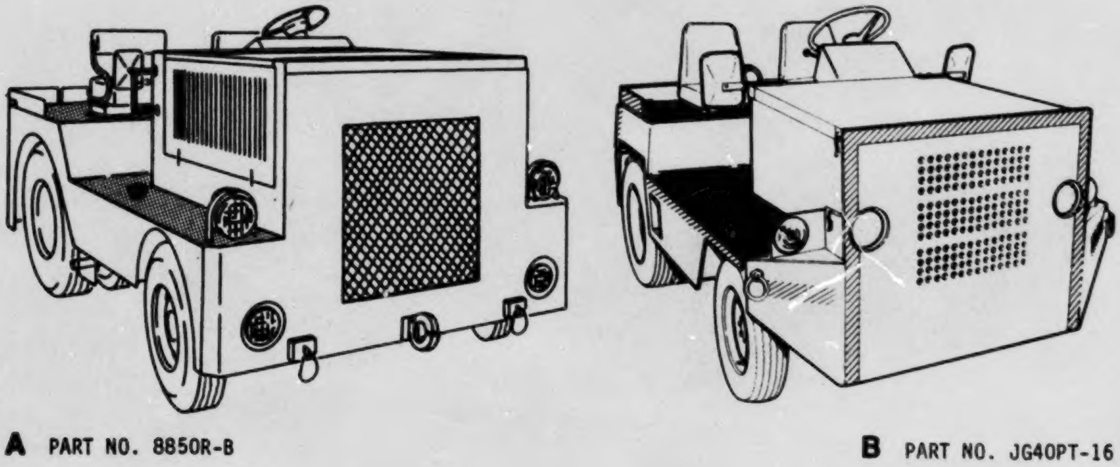


Figure 6-3.—Aircraft ground support equipment tractors, Type A/S 32A-30.

One of the major differences in the two tractors is the engine. The first tractors were manufactured with a part number of 8850R-B and use a Chrysler LH318 V-8 engine (see [A] in figure 6-3) and the second manufacturer of these tractors has a part number of JG40PT-16. These tractors use the Chrysler H 225 slant 6 engine (see [B] in figure 6-3).

MD-3 TOW TRACTOR

This tractor was designed for use aboard aircraft carriers and will handle any type of carrier-based aircraft. It can be configured as an MD-3 (basic tractor—no gas turbine power unit), MD-3A (mounts a GTCP-100-54 gas turbine power unit), or MD-3B (mounts a GTC-85-72/73 power unit). The MD-3A is shown in figure 6-4.

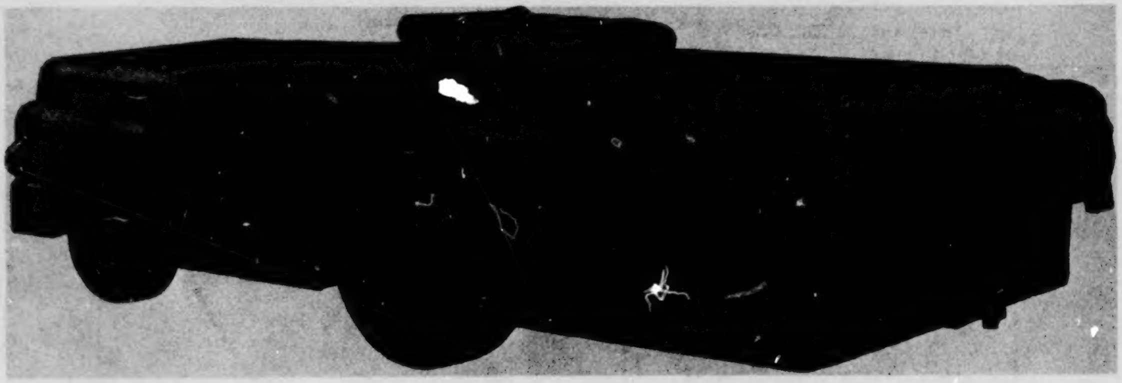
The MD-3 tow tractor is a self-contained unit capable of developing 8,500 pounds drawbar pull at an approximate speed of one mph on a dry concrete surface. The main powerplant of this type tractor is an inline horizontal, four-stroke cycle, diesel engine. The steering system is hydraulically assisted and the service brakes are assisted by compressed air. The gross weight of the MD-3 tractor is 12,000 pounds.

The transmission is a multiple reduction drive unit that shifts automatically in all forward gear ratios. It is bolted to the engine bell housing and is driven through a single-stage torque converter. A hydraulic control system regulates the transmission shifts. The system also synchronizes the engagement and release of the control clutches and brake bands to effect quick position shifts to meet load demands. The complete transmission system is lubricated, operated, and cooled by a single oil system.

A gas turbine compressor mounted at the rear of the tractor provides pneumatic power in the form of compressed air for the operation of large class pneumatic equipment, such as aircraft main engine starters (and other consumers of compressed air). The operating controls for the gas turbine compressor are located on a panel on the right-hand side of the operator's compartment. Compressor operation is outlined on two instruction plates adjacent to the controls.

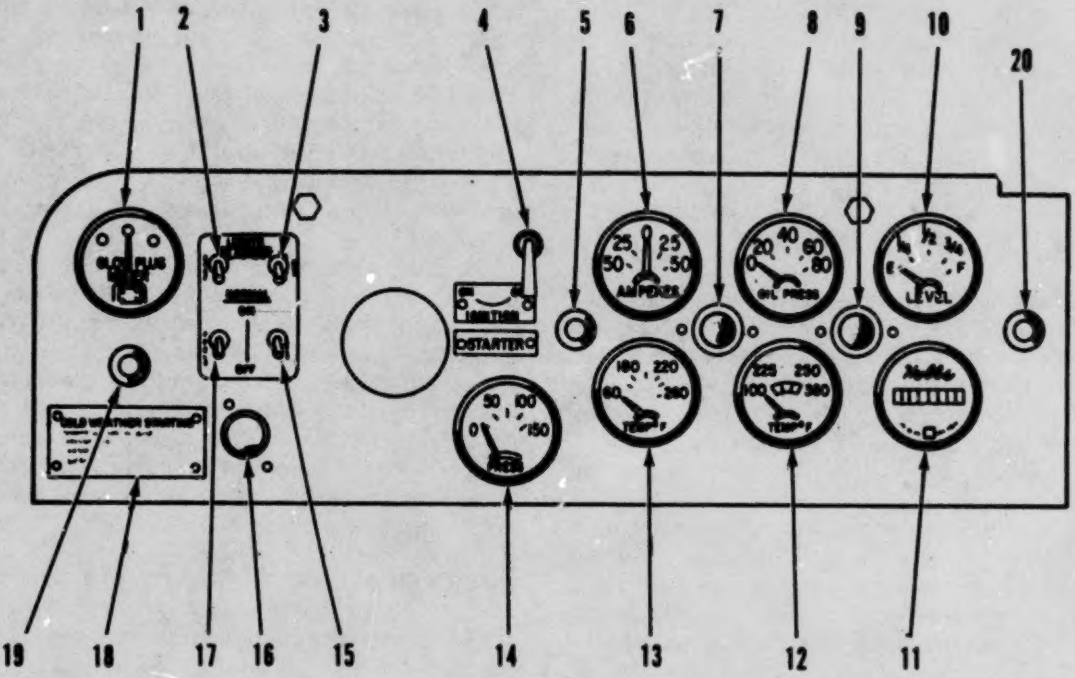
OPERATION OF TOW TRACTORS

As an AS you are required to operate the tractors when training personnel, in troubleshooting, and in testing after repairs have been made. Therefore, you must be familiar with the instruments and controls. Figure 6-5 shows the instrument/control panel and figure 6-6 shows other controls of an MD-3 tractor.



199.10

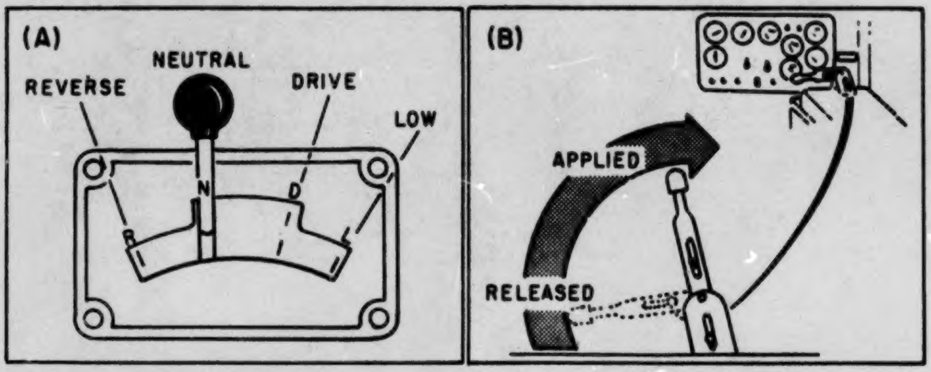
Figure 6-4.—MD-3A tow tractor.


1
2
3
4
5
6
7
8
9
10
20
GLOW PLUG
AMPERES
OIL PRESS
LEVEL
IGNITION
STARTER
PRESS
TEMP °F
TEMP °F
COLD WEATHER STARTING
19
18
17
16
15
14
13
12
11

1. Glow plug meter.
2. Stoplight switch.
3. Headlight switch.
4. Ignition switch.
5. Start switch.
6. Ammeter.
7. Dash lamp.
8. Engine oil pressure gage.
9. Dash lamp.
10. Fuel gage.
11. Hourmeter.
12. Torque converter temperature gage.
13. Engine temperature gage.
14. Air pressure gage.
15. Instrument light switch.
16. Air low-pressure warning light.
17. Pintle light switch.
18. Instruction plate.
19. Glow plug switch.
20. Horn button.

226.5

Figure 6-5.—MD-3 instrument/control panel.


(A)
NEUTRAL
REVERSE
DRIVE
LOW
R
N
D
L
(B)
APPLIED
RELEASED

225.21

Figure 6-6.—MD-3 controls. (A) Shift pattern; (B) Parking brake lever operation.

As mentioned previously, the operating procedures for the various types and models of tow tractors differ in some respects. The operation of the MD-3 is used as a representative example in the following discussion. It should be emphasized that the current applicable operation instructions should be consulted for the correct and specific operating procedures.

Before attempting to operate any type of equipment, you should be familiar with its instruments and controls. Procedures for starting the MD-3 tractor depend on weather conditions. If the average ambient temperature is above 40°F, NORMAL starting procedures should be followed. If the average temperature is 40°F or below, COLD WEATHER starting procedures should be followed.

The normal starting procedures are as follows:

1. Apply the hand brake and shift transmission to N (neutral) as shown in figure 6-6.

2. Turn the ignition switch ([4] in figure 6-5) ON and push the starter button [5] until the engine begins firing regularly. Should the engine fail to start in 30 seconds, release the starter button and allow a 2-minute recovery time before each additional attempt to start. Excessive engine cranking at any one time may damage the cranking motor.

3. After the engine starts, check the engine oil pressure [8], water temperature [13], and the operation of the ammeter [6]. The ammeter should indicate a positive (+) charging rate.

CAUTION: Stop the engine if there is a sudden rise in engine temperature and/or no oil pressure.

The diesel engine of the MD-3 is equipped with glow plugs for cold weather starting. A glow plug is an electrical heating element installed next to each fuel injector and is used to preheat the injector and combustion chamber. The heating element is supplied with current from the battery. To complete this electrical circuit, the ignition switch [4] and the glow plug switch [19] must be ON. Operation of the glow plug is indicated on the glow plug meter [1]. Normal gage operation is indicated by the gage pointer moving to the far right when the glow plug switch is pressed.

Cold weather starting procedures are as follows:

1. Apply the hand brake and shift the transmission lever to N (neutral).

2. Turn the ignition switch [4] ON and press the glow plug switch [19] to preheat the engine combustion chambers. Allow the amount of preheat time as indicated in table 6-1. After the combustion chambers have been warmed, press the starter button. Do not release the glow plug switch until the engine begins firing regularly.

3. If the engine fails to start during the first 30 seconds of cranking, release the starter button to allow a 2-minute recovery period before another attempt at starting. Do not release the glow plug switch between start attempts.

4. After the engine starts, run it at a fast idle until the engine oil pressure gage [8] indicates oil circulation and the engine temperature gage [13] indicates that the cooling system is warm. Idle the engine until full air pressure is developed in the brake system. This is indicated by the air pressure gage [14] and the air low-pressure warning light [16]. The warning light is on whenever pressure in the air system is less than 60 psi. The

Table 6-1.—Glow plug preheating chart

Ambient Air temperature °F	Preheating time (minute)
60	0.5
30	1.0
0	1.5
-20	3.0

tractor should not be operated until the warning light is OFF and the air pressure gage indicates more than 60 psi.

CAUTION: Do not use glow plugs while the tractor is working. Damage to the engine may result.

To operate the tractor, apply the service brakes and release the parking brake. (See [B] in figure 6-6.) With the engine idling, use the shift lever to select the type transmission operation desired. (See [A] of figure 6-6.) Release pressure on the brake pedal and gradually increase the accelerator feed to start moving the tractor. The transmission should be operated in the following manner:

All normal forward driving and towing with light or moderate loads should be accomplished with the shift lever at D (drive). In this position the transmission automatically upshifts and downshifts between second gear and third gear (direct drive). Maximum acceleration is obtained by fully depressing the accelerator, causing the transmission to automatically downshift from third gear to second gear. When pressure on the accelerator is decreased, the transmission automatically upshifts.

The shift lever should be moved to L (low) when the tractor is used to tow near maximum loads (8,500 pounds drawbar pull), or ascend steep grades. In addition, engine braking power can be gained when the transmission is in this gear ratio. This braking power assists the braking action of the service brakes. The transmission will not upshift automatically from first gear while the lever remains at the L position.

The shift lever may be removed from L to D or from D or L at any tractor speed. If the shift lever is at D when the tractor is at a standstill and the accelerator is fully depressed, the transmission will automatically downshift from second gear to first gear. As tractor and engine speed increases, the transmission automatically shifts from first gear through second to third gear. The tractor must be brought to a complete stop before making the shift between D and R (reverse).

During tractor operation, the operator should listen for unusual sounds which may indicate trouble. Gages and instruments should be checked periodically. Any unusual gage indications, such as excessive temperatures or pressures, are warnings of possible troubles. For example, the torque converter temperature gage ([12] in figure 6-5) shows the temperature of oil leaving the converter. Readings vary with working conditions, but the converter temperature should never exceed 250°F.

AIRCRAFT SPOTTING DOLLY, SD-10

The movement of aircraft on shore stations and aboard aircraft carriers has historically been accomplished by means of a tow bar and manpower or a tow bar and tractor; however, in crowded areas these methods become ineffective. The aircraft spotting dolly (figure 6-7) can, while providing maximum maneuverability, tow, turn, and spot several types of aircraft as effectively in congested areas as in the open.

The SD-1D, manufactured by Consolidated Diesel Electric Corporation, is equipped with a 3-cylinder diesel engine and weighs 7,500 pounds. It has a lifting capacity of 16,000 pounds, and can operate under most aircraft as it is only 29 inches high. The spotting dolly can approach an aircraft head on, pick up the nosewheel, spin on its own axis, and tow the nosewheel directly out at any angle to the aircraft's original line of direction. It can turn an aircraft through 360 degrees while the landing gear pivots around a stationary point.

The nosewheel, when loaded on the lifting arms of the spotting dolly, is on a freely revolving turntable located between the two drive wheels of the spotting dolly. A differential drive system permits one drive wheel of the spotting dolly to be driven forward, the other in reverse. This allows the spotting dolly to spin completely about without moving the nosewheel.

The spotting dolly is a 3-wheeled device, two of the wheels are driven and the third is a free-wheeling caster. Control is accomplished through a single handle on the end of the control

225.4

Figure 6-7.—Aircraft spotting dolly, Model SD-1D.

arm. Steering is accomplished by pushing the handle left or right; speed and direction (forward or reverse) by twisting the handle. The operator may either walk with the unit, or ride on the operator's seat, controlling it with a single hand. Maximum speed for the SD-1D is two miles per hour loaded and five miles per hour unloaded.

The usual manner of loading an aircraft is to set the brakes on the main landing gear, lower the lifting arms of the spotting dolly, drive it under the nosewheel, insert two axle pins in the lifting arms, raise the lifting arms, release the aircraft brakes and drive away.

MOBILE CRANES

Mobile cranes are used both at shore stations and aboard ship. Those for shipboard use are usually smaller and to some degree more maneuverable than shore-based cranes. The mobile crane is an emergency vehicle primarily designed for use in aircraft salvage and rescue.

Maximum performance of the mobile crane, including its operating equipment, is dependent upon the frequency and scope of the maintenance rendered, plus the ability of the operator to properly operate the crane. Personnel to whom the crane is assigned should study the crane's technical manual prior to actual operation of the crane.

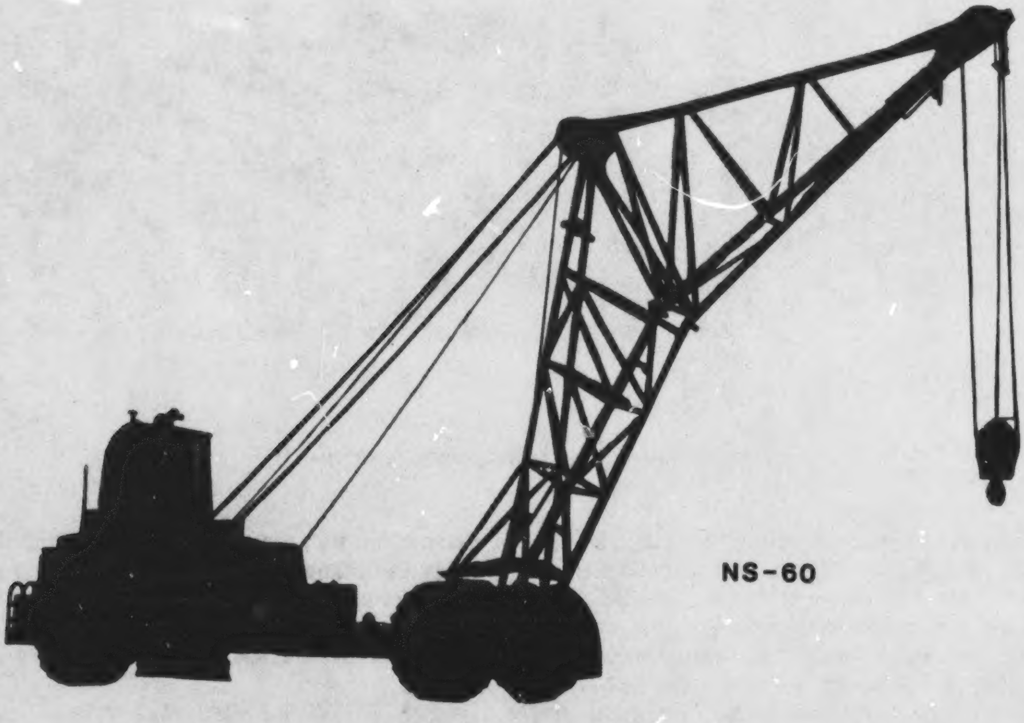
NS-60 MOBILE CRANE

The NS-60 mobile crane (figure 6-8) is designed primarily to lift and carry crashed aircraft on the flight deck of an aircraft carrier. The crane is equally suitable for similar duty on shore stations—both for aircraft landing areas and for paved or unpaved operational areas.

The crane, a self-propelled vehicle, is mounted on four electrically powered wheels. Heavy-duty d.c. electric traction motors and gear reduction units built within the wheel hubs provide motive power for the crane. Each wheel motor is equipped with multiple disc type spring-loaded brakes for emergency stops and parking, while an electrical braking system is used for operational deceleration of the crane.

The hook motor also operates on d.c. and, because of an electrical interlock, cannot be operated simultaneously with the wheel motors.

A.c. electric motors, strategically located at the point of power application, drive through reduction gear boxes to provide boom movement and steering. Each a.c. motor is equipped



199.23.1

Figure 6-8.—Mobile cranes.

with a multiple disc, spring-loaded brake that sets instantly when the motor's electrical power is interrupted, thus locking the boom in position. Restoration of the motor's electrical power automatically releases the motor brake.

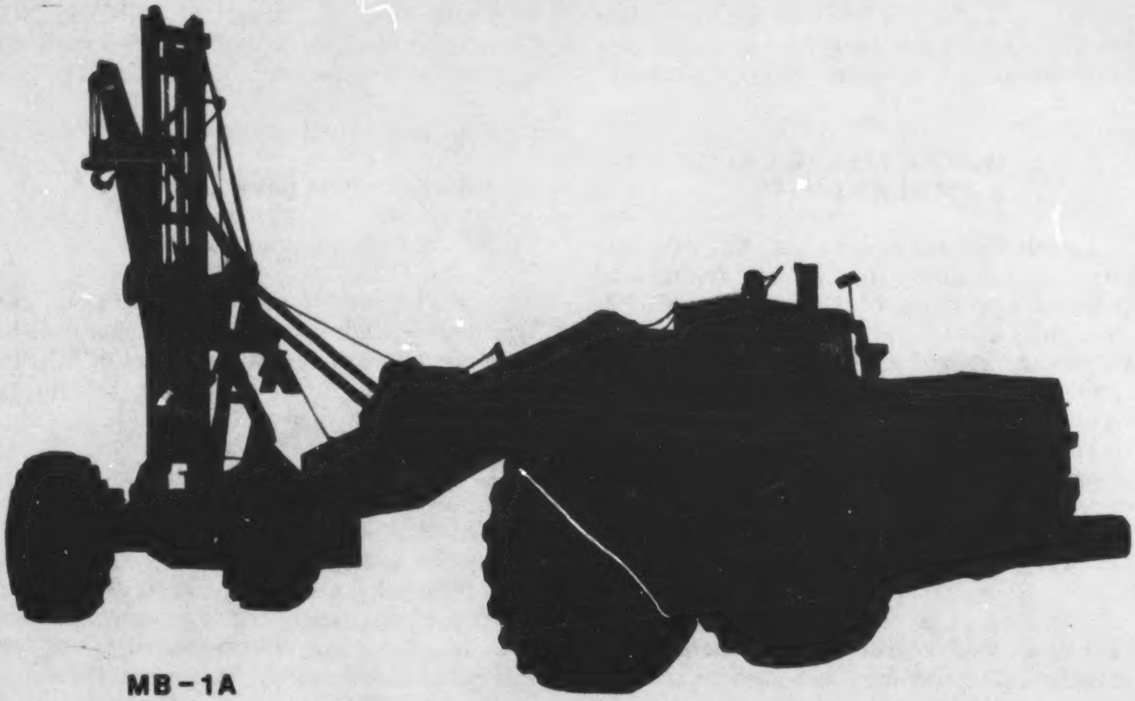
Two generators, one a.c. and one d.c., coupled directly to and driven by a 6-cylinder diesel engine, supply current to the control motors and the wheel motors. One control handle (potentiometer), located on the operator's control panel, provides control of the wheel motors or hook motor, whichever is selected by the operator, while fingertip switches on the control panel provide control of steering and boom movement.

A remote control panel having a 25-foot cable is stored in a compartment on the left side of the crane. This control panel allows the operator to maneuver the crane or to operate the hook motor, boom motor, and parking brakes from any point on deck up to a maximum of 25 feet.

The crane is capable of lifting and carrying 60,000 pounds with the boom at its minimum extension. Unloaded weight of the crane is 125,000 pounds.

Attached to the front of the crane is a stationary, bulldozer-type, push plate. Its purpose is to allow the crane to push away damaged aircraft or other material to clear the flight deck or runway.

An earlier version of the crane, the NS-50 (SC-7), is quite similar to the one just described. The main differences are the weight of the crane and its load capacity.



199.24

Figure 6-9.—Mobile cranes.

MB-1A MOBILE CRANE

The MB-1A mobile crane (figure 6-9) is designed to have good maneuverability in lifting and removing crashed aircraft from air station runways and surrounding areas. The MB-1A is made up of a 2-wheeled prime mover attached to a 2-wheeled crane.

The prime mover is powered by a diesel engine driving through a twin-disc clutch, a 5-speed transmission, a high/low-speed auxiliary transmission, and a torque-proportioning differential. The auxiliary transmission in combination with the 5-speed transmission results in 10 speeds forward and 2 speeds in reverse. The wheels of the crane are not powered.

An a.c. generator, driven from the engine flywheel, supplies current for powering the hook motor, jib motor, boom motor, and steering motor. These motors are controlled by fingertip switches located at the operator's station. A remote control box is provided for controlling the hook, jib, and boom motors from a position near the point of pickup.

Air brakes are provided on all four wheels. These brakes consist of alternate discs splined to the brake drum and brake hub. Air pressure directed to a pressure plate forces the discs together for braking. Springs are used to move the pressure plate to the released position when the air is bled from the brake. Selector valves are provided to control the selection of front, rear, or both brake sets.

There are three stations where sound-powered telephones may be connected. One station is in the cab by the operator, and the others are located at the left side of the crane tongue and at the rear of the crane. To use, simply plug in the phone jack at one of the station outlets.

MOBILE ELECTRICAL POWER PLANTS

Mobile electrical power plants (MEPPs) supply electrical power for various testing and checkout operations of aircraft. The MEPPs used today are designed for operation on shore stations and aboard aircraft carriers. On aircraft carriers these units are usually of the mobile type, with minimum vehicular dimensions and weight; they are usually designed for utmost maneuverability and mobility. On shore stations these units may be mobile, self propelled, large in size, or may be trailer-mounted and require towing.

There are four categories by which the MEPPs are readily identified: (1) vehicular, self-propelled; (2) trailer-mounted, gasoline or diesel engine driven; (3) trailer mounted, electrically driven; (4) dolly/skid mounted, gasoline/diesel engine driven or electrically driven. The various categories of power plants may be further identified by prefix letters NA, NB and NC. These letters indicate the type of power available from the unit as follows:

NA—d.c. output power only

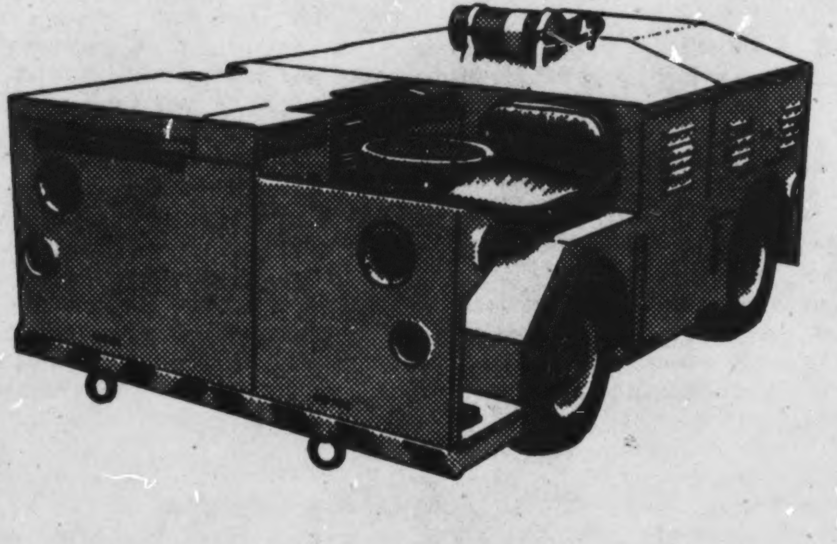
NB—a.c. output power only

NC—a.c./d.c. output power

There are many types of MEPPs in use. The type used depends upon the type of aircraft to be serviced. Three of the various types of MEPPs are described briefly in the following paragraphs.

NC-2A MEPP

The NC-2A (figure 6-10) is designed primarily for emergency use aboard aircraft carriers. (Normally, deckedge power is used.) It is a self-propelled diesel engine-powered service unit. It is front axle-driven, steered by the two rear wheels, and readily maneuverable in congested areas. The vehicle has a turning radius of 130 inches. The front axle is driven by a 28-volt d.c. reversible, variable speed motor, capable of propelling the unit up to 14 mph on level terrain.



225.118

Figure 6-10.—MEPP NC-2A.

The primary source of power is a 3-cylinder, water-cooled diesel engine which drives the a.c. and d.c. generators through a speed increasing transmission. All controls, both propulsion and electrical power, are available to the operator on three panels located in front and to the right of the operator's seat.

The power plant is designed for air transport and is provided with two tiedown rings each on the front and rear bumpers. Forklift channels are located between the front and rear axles, providing safe lifting points for the unit.

NC-8A MEPP

The NC-8A (figure 6-11) is a mobile, self-propelled, diesel engine-powered service unit which is utilized for starting and servicing rotary and fixed wing aircraft. It is capable of providing 400-hertz, 3-phase, 120/208 vac, 60-kva power, and 500 amperes (current limited) intermittent power.

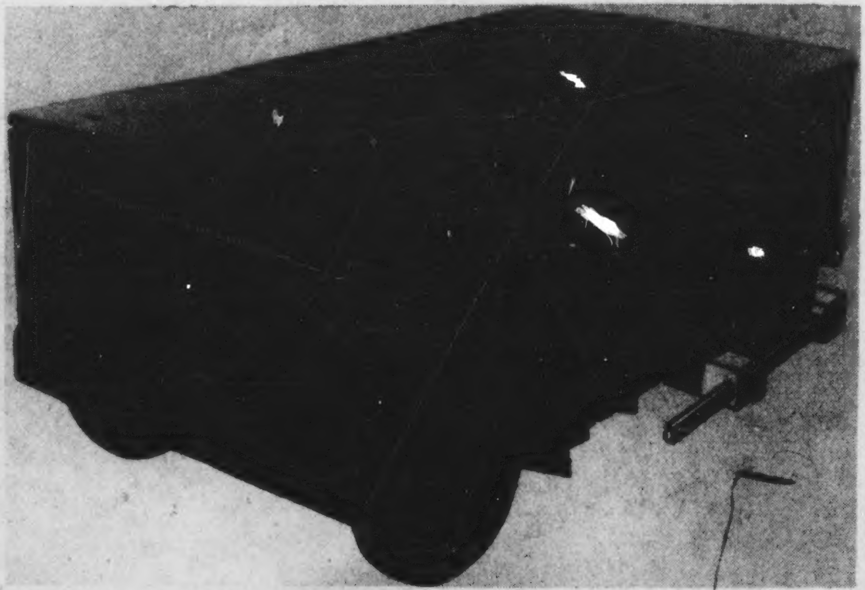
The NC-8A mobile electric power plant is a four-wheel, front-steering, electric motor-propelled vehicle with a dual voltage a.c./d.c. generator, and a water-cooled, four-cylinder, two-stroke cycle diesel engine.

Like the MEPP NC-2A, this power plant is designed for air transport and is provided with four tiedown rings, two each on the front and rear bumpers. Forklift channels are located between the front and rear axles, providing safe lifting points for the unit.

Power Supply/Transformer Rectifier (T/R Unit)

The power supply/transformer rectifier referred to as a T/R unit is an add-on unit for the NC-8A. It supplies jet starting power for aircraft with electric starters. The a.c. input power of 208 volts 3-phase 60 kva and 400 hertz from the NC-8A is supplied to the T/R unit to produce a d.c. output of 28 or 35 volts and 750 or 1000 amperes for jet start.

OPERATION OF THE TRANSFORMER-RECTIFIER UNIT.—The following is the operation and starting cycle of the T/R unit.



225.134

Figure 6-11.—NC-8A mobile powerplant.

When the start signal is received to start the aircraft, the output voltage from the T/R unit rises to approximately 6 volts. The limited voltage rise prevents current inrush and sudden mechanical shock to the aircraft starter prior to and during the time the starter dog engages with the engine.

While maintaining low voltage, the aircraft jet engine starting contactor closes, delivering current to the starter motor. After a current flow of approximately 100 amperes, the starter dog engages with a minimum of force. The voltage now starts to rise while the current is limited by the voltage regulator to a value of 1000 to 1100 amperes. While the T/R unit is in a current limit status, the output voltage reduces to a level determined by the starter motor impedence.

As the aircraft starter motor speed increases, its counter electromotive force (CEMF) also increases, reducing the current demand. As the current decreases, the voltage is permitted to increase up to 35 volts (or 28 volts if the unit has the capability and the switch is in this position) and is held constant by action of the voltage regulator. As the starter motor speed increases, so does its counter emf. This decreases the amount of current flow. When the starter current decreases to approximately 235 amperes, the undercurrent relay or speed switch in the aircraft drops out, electrically disconnecting the T/R unit from the aircraft starter motor. When the current demand has decreased to its dropout value (235 amperes), the jet engine RPM is high enough to accelerate without external aid.

NC-10B MEPP

The NC-10B (figure 6-12) is a diesel engine-driven unit designed for shipboard or shore station use. This unit supplies 90-kva, 120/208-volt, 3-phase, 400-Hz power for servicing, starting, and maintaining helicopters and jet aircraft. A portion of the electrical power generated is rectified to supply 28 volts d.c. at 750 amperes (1,000 amperes intermittent) for aircraft starting.

225.137

Figure 6-12.—MEPP NC-10B.

The powerplant is enclosed in a steel housing, fabricated in two sections which are easily removed for servicing the unit. Operating components are mounted on a four-wheel trailer which is equipped with mechanical-type internal expanding wheel brakes. The brakes may be set by hand lever, and set automatically when the tow bar is in the vertical position.

Double-hinged doors provide access to the control panel, starting components, and three output power cables.

The plant's electrical system is protected from overload by output circuit contactors, circuit breakers, overvoltage and undervoltage relays, overfrequency and underfrequency relays, thermal overload relays, and fuses.

The unit is self-propelled, for movement between aircraft on the line, by two hydraulic wheel motors. The operator's control is located on the tow bar. Hydraulic pressure is supplied by the hydraulic system which also provides pressure to operate the engine starter and the electrohydraulic governor's actuator system.

MOBILE MOTOR-GENERATOR SETS

Mobile motor-generator sets (MMGs) perform the same function as the mobile electric powerplants, but they are not self-contained and require an external source of electrical power for operation. The MMG-1/A and MMG-2 are primarily used in hangars on shore stations, or on the hangar decks of aircraft carriers where the running of an internal combustion engine would be objectionable and where external power (220-440/60Hz) is readily available.

MMG-2

The MMG-2 (figure 6-13) is physically quite small and compact. It is a trailer-mounted electric motor-driven generator set used to provide 120/208-volt, 400-Hz, a.c. power, and 28-volt d.c. power for use in ground maintenance, calibration, and support for all fighter/interceptor type aircraft equipment.

207.153

Figure 6-13.—MMG-2.

FLIGHT LINE ELECTRICAL DISTRIBUTION SYSTEM (FLEDS)

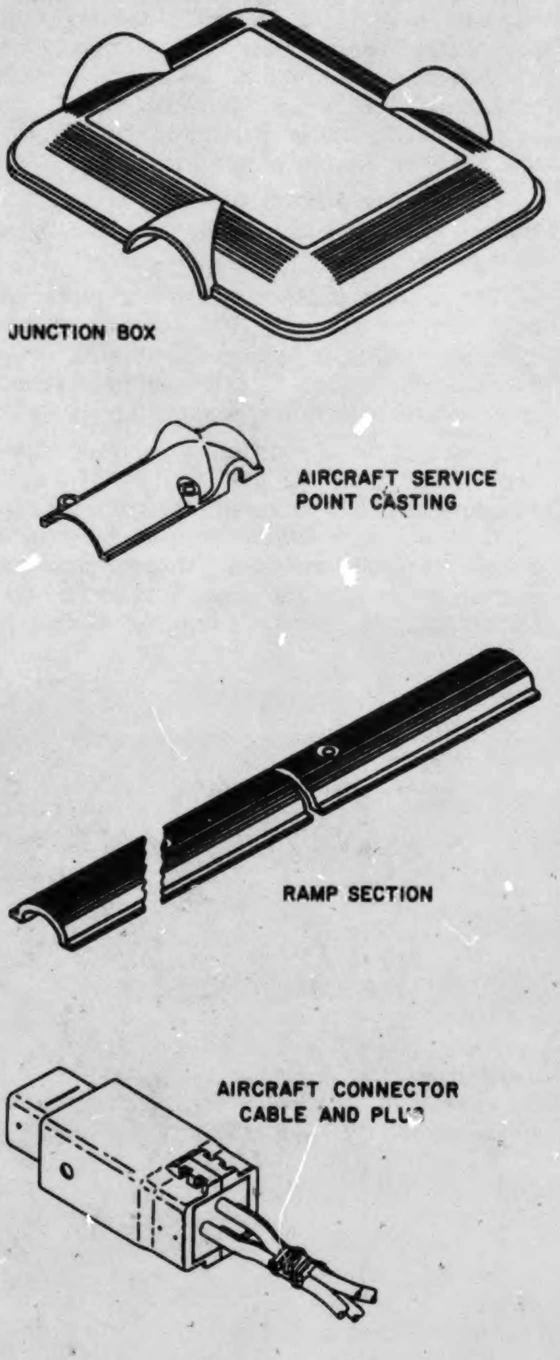
The FLEDS is an electrical distribution system for servicing aircraft on the flight line. Figure 6-14 shows the major parts of the FLEDS. It consists of 3-way junction boxes, interconnecting ramps, aircraft service point castings, and aircraft connector plug assemblies. The total system capability is 24 aircraft (figure 6-15). Each service point can service one aircraft with 115/200 volts, 3-phase, 400-hertz power.

The FLEDS accepts power from a Mobile Electric Power Plant (MEPP) capable of supplying 115/200-volts, 3-phase, 400-hertz power. Power is applied at the junction boxes and branches into the service point castings to the aircraft connector plug assemblies. The cables connecting the junction boxes, service point castings, and aircraft connector plugs are installed underneath the interconnecting ramps for protection.

FORKLIFT TRUCK

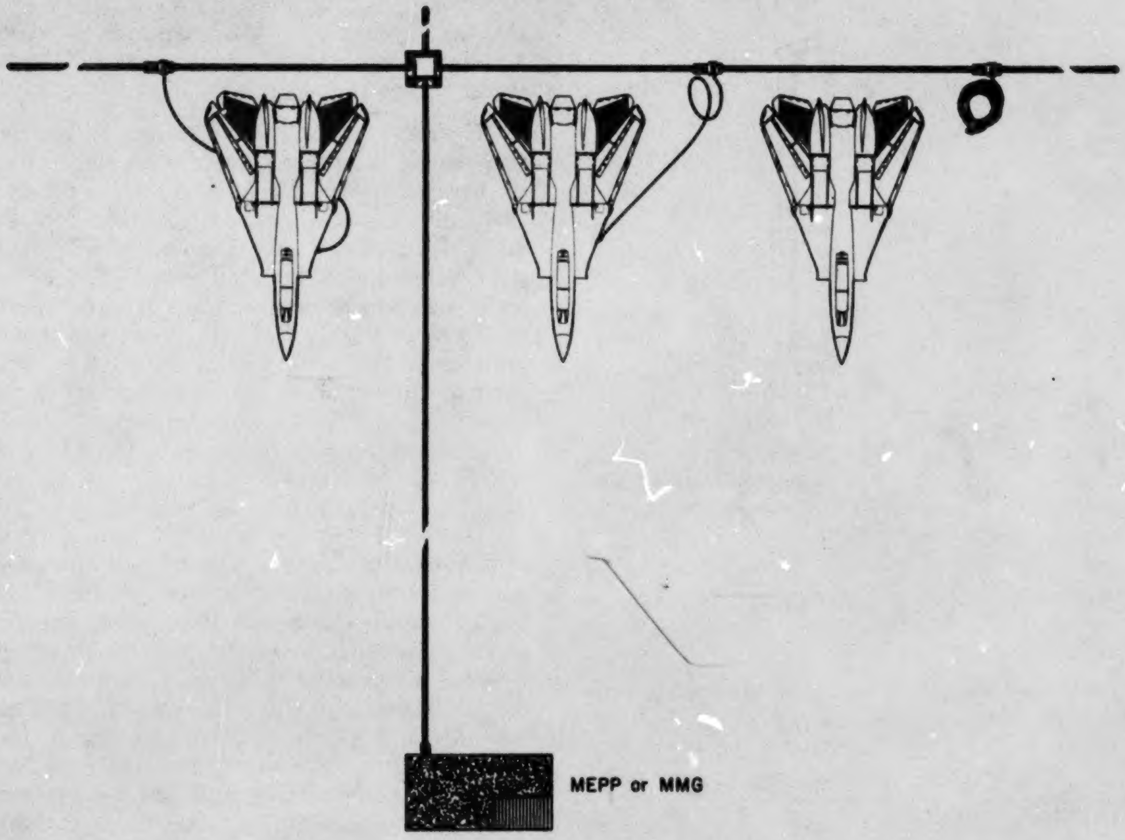
The forklift truck is a much used, power-driven piece of material handling equipment. It is a cantilever type of industrial truck—either diesel-, gasoline-, or electrically-operated with either three or four wheels. It contains vertical uprights and an elevator backplate equipped with two or more forks of sufficient length and thickness for use with various types of pallets. (See figure 6-16.) Forklift trucks that come under your care as an AS are powered by diesel and gasoline engines and have pneumatic or solid rubber tires. Forklift trucks are generally used to handle palletized unit loads but may also be used to haul boxes or containers equipped with skids as well as other large containers and packages. They are used to hoist heavy loads into aircraft. They are also used to move loads aboard carriers, onto barges, onto piers, in warehouses, and in and around freight terminals.

The forklift truck must be operated only by a licensed operator. The servicing and upkeep are similar to those required for any automotive equipment.


JUNCTION BOX
AIRCRAFT SERVICE POINT CASTING
RAMP SECTION
AIRCRAFT CONNECTOR CABLE AND PLUG

227.113

Figure 6-14.—Major components of FLEDS.



227.114

Figure 6-15.—FLEDS.

PREHEATERS AND AIR CONDITIONERS

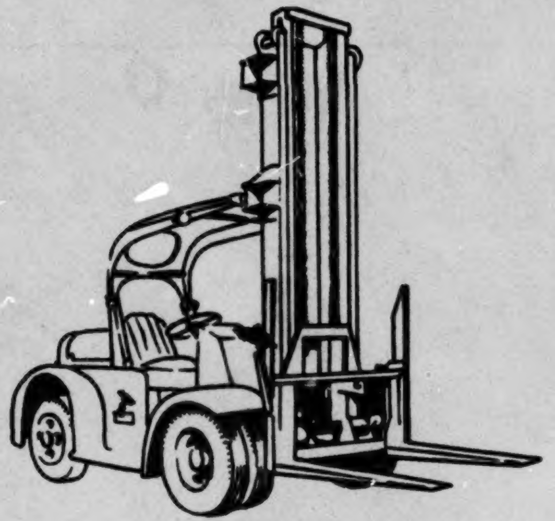
Preheaters and air conditioners are used in maintaining desired temperatures in aircraft on the ground. In the following paragraphs, an example of each type of unit is discussed.

PREHEATERS

The NPH-3 portable preheater produces up to one million BTU per hour for ground heating of aircraft, portable shelters, or any space requiring heat. It is a box-shaped, four-wheeled, towed vehicle that has expanding-type parking brakes on the rear wheels. It is powered by a two-cylinder, air-cooled engine developing 13.6 horsepower. This engine drives a ventilating air blower and a generator. The blower forces air through the heater and through the outlet ducts. The generator actuates the spark plug to ignite the combustible mixture in the combustion chamber of the heater. The heater burns the same gasoline as the engine. Twin outlet ducts can supply heat through 30 feet of 12-inch ducts.

AIR CONDITIONERS

Air-conditioning units are designed to provide ground ventilating and cooling for aircraft



215.192

Figure 6-16.—Forklift truck.

cabins and electronic systems. Most units perform the following functions:

1. Cool aircraft avionics equipment compartments.

2. Ventilate equipment compartments at ambient temperatures where cooling is not required.

3. Cool occupied aircraft cabins.

4. Cool pressurized personnel suits.

Air-conditioning units are usually trailer-mounted. The unit is usually powered by either a gasoline engine, a diesel engine, or an electric motor. Air-conditioning units are identified by the letter designation NR, followed by a model number. NR-2B, NR-3A, NR-5C, and NR-10 are all different models of air conditioners. The NR-5C and NR-10 are briefly described in the following paragraphs.

NR-5C Air Conditioner

The NR-5C air conditioner (figure 6-17) is a mobile, trailer-mounted unit and is electric-powered by a 30-horsepower, 440-volt, 3-phase, 60-cycle electric motor which is an integral part of the compressor.

The unit is mounted on four wheels. The two rear wheels are non-steerable, shock-absorbing on heavy duty cushion tread tires. Two swivel shock-absorbing wheels are provided on the center front of the unit. The rear wheels incorporate parking brakes that are applied or released by a single manual control lever located at the front of the unit. Access doors and panels are provided for full accessibility. Four lifting rings are mounted on the upper corners of the unit.

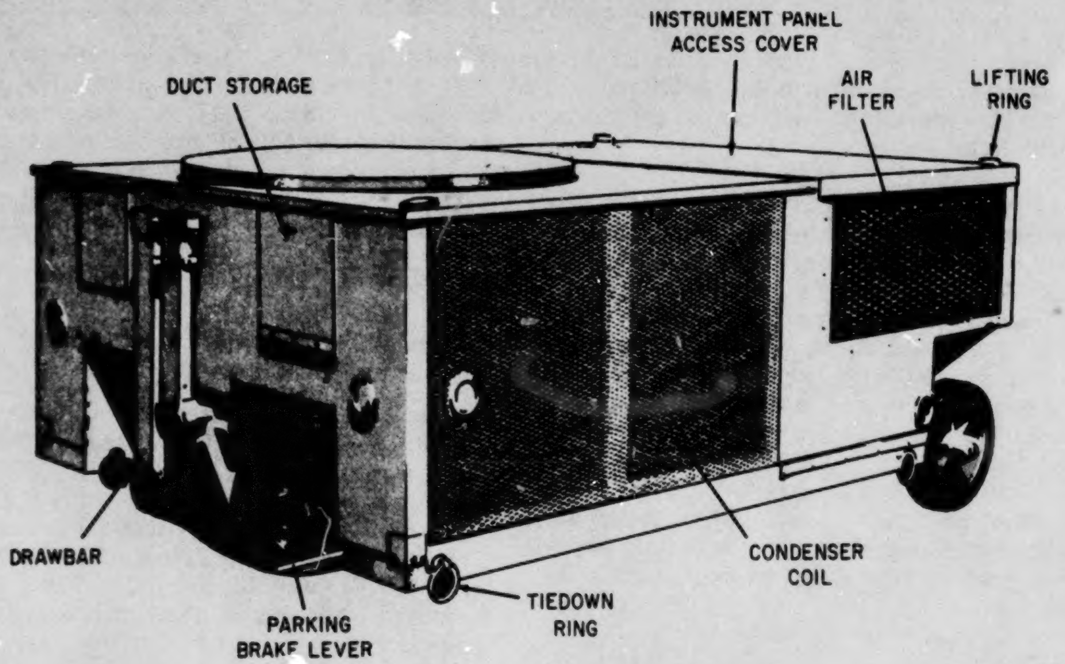
NR-10 Air Conditioner

The NR-10 air conditioner (figure 6-18) is also a mobile, trailer-mounted, self-contained air-conditioning unit. A six-cylinder, turbocharged, 82-horsepower diesel engine supplies all the power for the operation of the air conditioner. Incorporated in the engine are a manual throttle, water pump and thermostat, oil filter, fuel injection pump, fuel transfer pump, fuel filters, variable speed governor, overspeed control, thermal protection and low oil pressure safety switches, generator, and starting circuits.

The engine is liquid-cooled by means of a radiator. Air flow through the radiator is provided by the condenser fan. The axle assembly consists of the tow bar and four independent suspension wheels. The tow bar assembly is designed so that when the front wheels attain their maximum angular position, a cam on the towbar assembly is released allowing the towbar to continue following the motion of the towing vehicle. All four wheels are provided with braking.

GAS TURBINE POWER SERVICING EQUIPMENT

Gas turbine power units are driven by gas turbines. Although they all employ similar gas turbine engines, there are several different types and configurations of gas turbine power equipments. Basically, these units provide air for jet starting and in some cases provide electrical


INSTRUMENT PANEL ACCESS COVER
DUCT STORAGE
AIR FILTER
LIFTING RING
DRAWBAR
CONDENSER COIL
TIEDOWN RING
PARKING BRAKE LEVER

227.86

Figure 6-17.—NR-5C air conditioning unit.

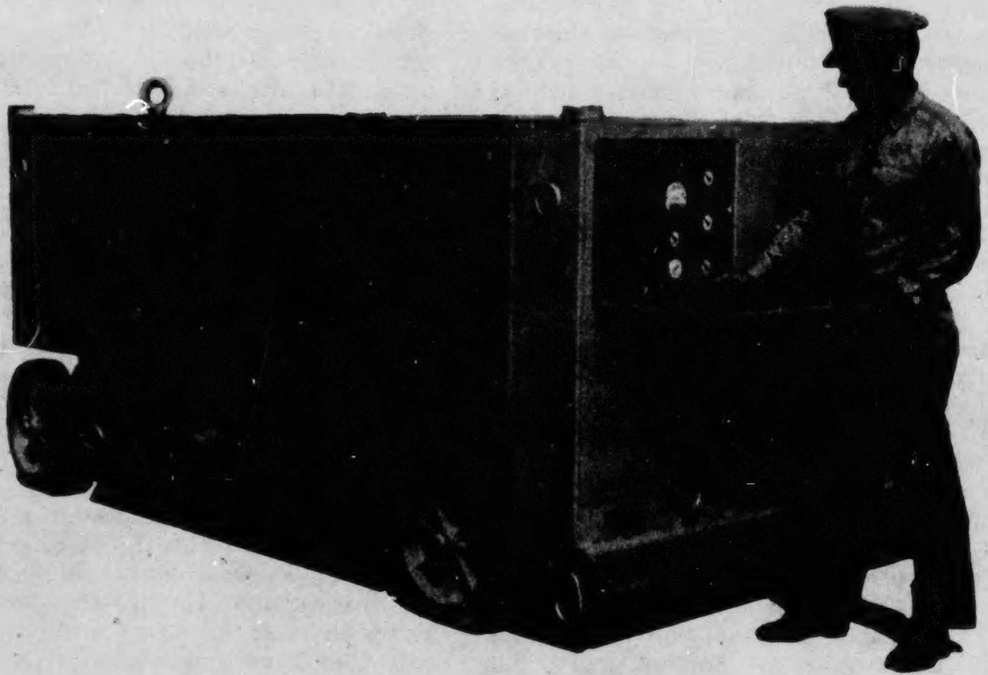


Figure 6-18.—NR-10 air conditioner.

225.25

power for servicing or starting aircraft. These units may also be used to supply air for safe removal of snow or ice from aircraft and carrier flight decks.

Gas turbine power equipments are largely self-contained and require only an outside source of fuel and oil to maintain a constant output. The units may be enclosed in a skid-mounted enclosure, housed in an aerodynamic pod, or mounted on the rear of a tow tractor, such as the MD-3 described previously in this chapter. When housed in an aerodynamic pod, these units are designed to be transported on the bomb shackles under the wings of jet aircraft. The pod is mounted on detachable wheels or on a bomb trailer when in use. The inspection, maintenance, and repair of gas turbine power equipment are your major responsibilities as an AS.

GTC-85

The GTC-85 gas turbine engine is basically a two-stage centrifugal compressor directly coupled to a radial inward-flow gas turbine. Compressed air is obtained as bleed-air from the second stage of the compressor at a 3.6:1 pressure ratio. This pneumatic power (bleed-air) is used for the operation of large pneumatic equipment which is basically that of jet aircraft turbine starters.

The following is an explanation of model number identification. The GTC-85-72 and GTC-85-73 are the two GTC-85 turbines used most in GSE. Gas turbine compressor model number GTC-85-72 is used as an example.

> GTC—A group of letters selected from the title of the unit to reduce the title to a symbol.
>
> 85—Indicates a specified design or type unit.
>
> 72—Denotes a basic design configuration and indicates that all units bearing this dash number are interchangeable, but noninterchangeable with other units bearing a different dash number.

The GTC-85-72/73 engine mounts in a GTE-85 enclosure (GTE = Gas Turbine Enclosure). Some GTE-85 enclosures are mounted on the MD-3B tow tractor and other enclosures are mounted on trailers. GTC-85 and GTC-100 are different models of gas turbine compressor engines.

NCPP-105

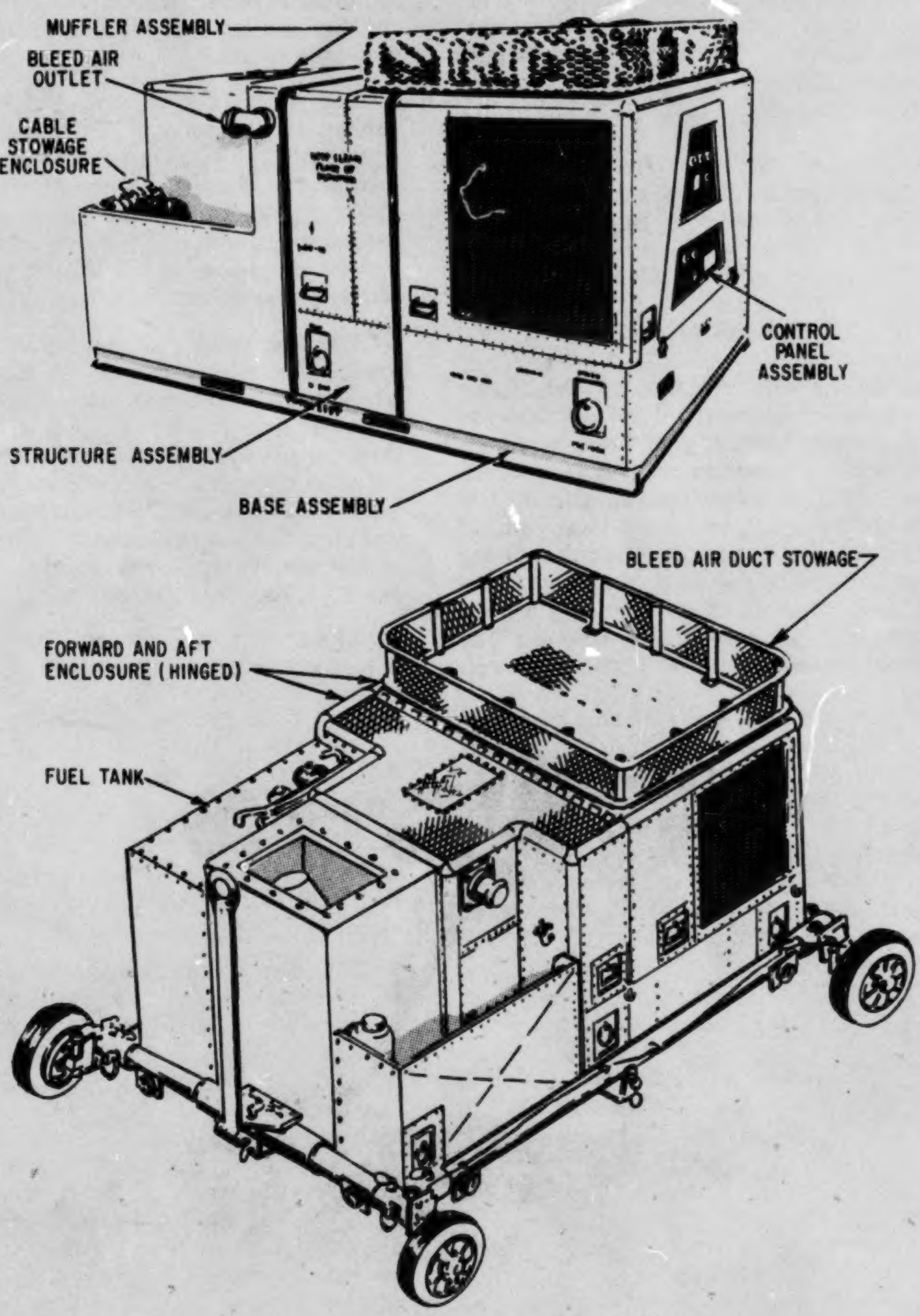
The NCPP-105 with the GTC-100-54 is described briefly in the following paragraphs.

The NCPP-105 (figure 6-19) is a complete, self-contained unit consisting of a flyaway assembly enclosed in a skid-mounted, weather-resistant enclosure. The top view of figure 6-19 shows the NCPP-105 as a skid-mounted unit. This unit can be installed on a trailer, as shown in the lower view of this figure. This permits ease of movement from aircraft to aircraft and from place to place.

The NCPP-105 supplies compressed air at two pressure ratios (5:1 and 3.6:1) for aircraft engine starting, and a.c. and d.c. electrical power for operation of aircraft a.c. and d.c. electrical components. It is equipped with a remote cable assembly, an a.c. output cable, a d.c. output cable, and a bleed air duct assembly.

The unit enclosure consists of a forward and aft closure (hinged together), a cable stowage enclosure (hinged together), muffler assembly, fuel tank structural assembly, and a base assembly.

The flyaway assembly is normally operated while in the NCPP-105 enclosure, with the d.c. power supply mounted in the forward enclosure. However, when it is required to transport the flyaway assembly by aircraft to a temporary location, the d.c. power supply is removed and relocated on the flyaway assembly structure. The fuel line and a.c. and d.c. electrical output cables are disconnected, the forward and aft enclosures are lifted off the structure assembly, and the flyaway assembly is then removed from the base assembly. The flyaway assembly, with its remote cable, a.c. and d.c. electrical output cables, and bleed air duct assembly, upon arrival at its temporary location, can be operated by attaching it to a fuel supply.


MUFFLER ASSEMBLY
BLEED AIR OUTLET
CABLE STOWAGE ENCLOSURE
CONTROL PANEL ASSEMBLY
STRUCTURE ASSEMBLY
BASE ASSEMBLY
BLEED AIR DUCT STOWAGE
FORWARD AND AFT ENCLOSURE (HINGED)
FUEL TANK

213.17

Figure 6-19.—Model NCPP-105 compressor power unit.

The control panel is part of the flyaway and is located on one end of the NCPP-105 unit, as shown in figure 6-19. The control panel contains the complete operating instructions for the operation of the unit.

NOTE: The NCPP-105 flyaway assembly cannot be hung as an external store and must be transported inside a transport or cargo-type aircraft.

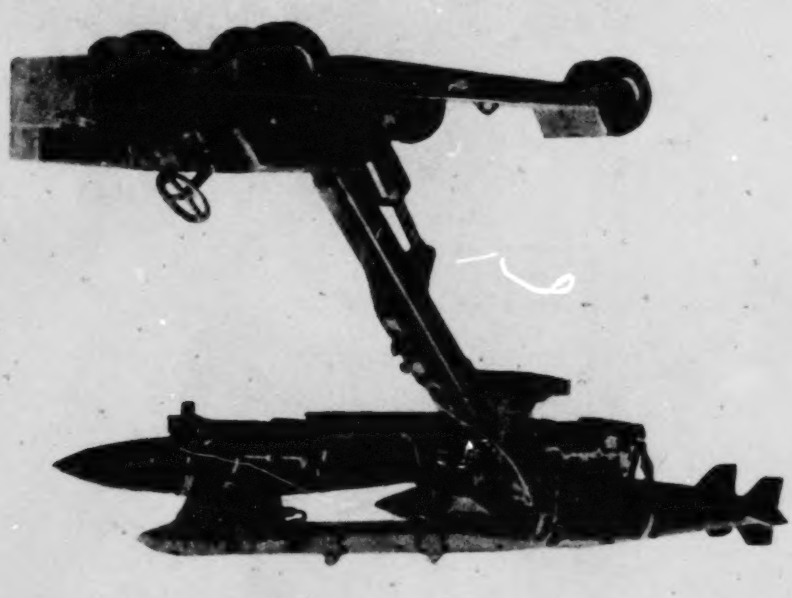
WEAPONS LOADER

The AERO 47A Weapons Loader (figure 6-20) is designed primarily for the U.S. Navy to load externally carried munitions, weapons, JATO bottles, ammunition cans, rockets, pylons, and fuel tanks onto tactical aircraft. It is used to lift, transport, and attach these items of varying size, weighing up to 4,500 pounds, to the wing and centerline pylons of the aircraft. All lifting and manipulating functions of the weapons loader are hydraulically powered. The vehicle is powered with a 27.5-horsepower, multifuel burning engine which provides power for the movement of the vehicle as well as the hydraulic system.

The AERO 47A is controlled in a manner similar to conventional forklift trucks. It is equipped with hydraulic powered steering which provides a turning radius of 15 feet. All hydraulic motions, including the lifting mechanism, incorporate safety features which prevent movement of the load in the event of mechanical or hydraulic failure.

The application of this loader in aircraft loading operations permits the loading of all weapons with a two-man crew. Since the loader permits transportation and handling of prepackaged multiple suspension racks, operations such as individual weapon attachment, sway bracing, fuzing, attaching arming wires, and preliminary rack checkout can be performed as a prestaging operation. Loading time at the aircraft is reduced to minimum.

AERO 47A has conventional automotive power steering. The drive train consists of a



225.23

Figure 6-20.—Aero 47A weapons loader.

single dry disc automotive clutch, a standard 3-speed transmission, a 2-speed transfer case, and a limited slip differential to ensure positive traction. Brakes consist of a mechanical parking brake on the rear wheels and hydraulic service brakes on the rear wheels and two inside front wheels.

P-36 AIRFIELD MAINTENANCE TRUCK

The P-36 airfield maintenance truck (figure 6-21) is a platform truck capable of hauling loads up to 3,600 lb. A 34-horsepower, four-cylinder, air-cooled engine provides the power. The open operator's compartment is located at the front of the truck beside the engine. The transmission and steering are manually operated. The ignition system is the coil and distributor type. The maximum governed speed of the engine is 2,175 rpm producing a top speed of 15 mph. Hydraulically operated brake shoes inside each wheel brake drum provide a means of braking the truck. The standard shift transmission unit provides two forward speeds and one reverse speed. The six volt lead acid storage battery, generator, and voltage regulator system is the source of power for the starting, ignition, and lighting systems.

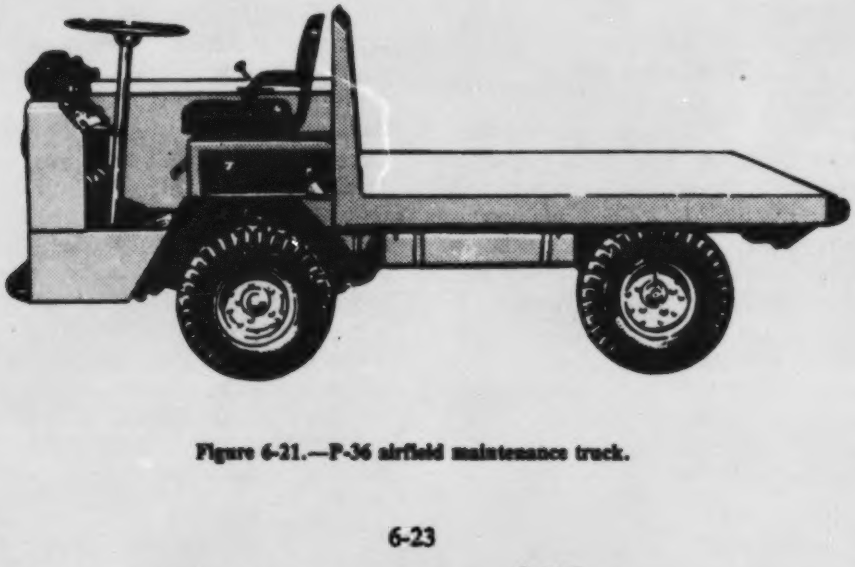
This truck is used around airfields for general hauling. It can be used for off-paved surface hauling at low speeds but has only a five-inch clearance. It is provided with a coupler on the rear of the frame to facilitate towing trailers or other vehicles.

AIRCRAFT FIREFIGHTING AND RESCUE EQUIPMENT

MB-5

Most aircraft firefighting and rescue equipment used on shore stations is maintained by the Public Works Department. On board aircraft carriers, personnel of the AS rating are concerned with the maintenance of this type of equipment. An example of such equipment is the MB-5 Aircraft Firefighting and Rescue Truck.

The MB-5 fire truck you will encounter (figure 6-22) is manufactured by the Oshkosh Truck Corporation and is used on board some aircraft carriers. The MB-5 was designed for shore stations and they are being replaced by units designed for carriers. The main engine is mounted on the rear of the chassis with the fan and radiator to the rear. This engine is a six-cylinder diesel engine displacing 638 cubic inches and rated at 273 horsepower at 2,200 rpm. An exhaust-driven turbocharger compresses the inlet air before it enters the cylinders. When first started, a speed limiting device limits the engine



225.218

Figure 6-21.—P-36 airfield maintenance truck.

226.6

Figure 6-22.—MB-5 aircraft firefighting and rescue truck.

speed until lubricating oil pressure builds up to a safe operating range. The full pressure lubrication system also bypasses the oil cooler and filter when the engine is first started until the temperature of the oil increases to a high enough temperature to flow unrestricted through the oil passages. Oil sprayed on the underside of the pistons assists in cooling the pistons, in addition to providing lubrication. All moving parts of the engine are either pressure-lubricated by a gear type pump or splash lubricated.

The engine is of the overhead valve design using mechanical lifters and push rods. Passages in the block and cylinder head circulate a coolant to cool the valves. Thermostatically controlled radiator shutters and a regulator valve in the water jacket restrict the flow of water and cooling air through the radiator to decrease the warmup time of the engine and maintain proper engine operating temperature. The cooling system is pressurized for safe operation at higher than normal temperatures. The coolant is circulated by a centrifugal water pump through the engine oil cooler and the water-cooled air compressor as well as the normal passages. The air compressor, driven by the engine, provides air pressure for the operation of the hydraulic brake system power assist unit, radiator shutter cylinder, windshield wipers, and other units.

The transmission is semiautomatic and provides four speeds forward, neutral, and one reverse speed. The transmission gear selector is located to the right of the driver's seat. Under normal conditions, the vehicle can be operated in 4th gear. In this position the transmission automatically upshifts and downshifts with the increase and decrease of engine speed. For off-road or heavy pulling operations, a lower gear range should be selected. When the selector is in one of the lower gears, the tachometer should be observed for indicated engine speed. When the engine speed reaches 2,200 rpm, the transmission should be shifted to the next higher gear range. A smooth shift can be obtained if the accelerator is released momentarily while shifting. The lower ranges are also used to aid in braking the vehicle when descending steep grades. However, engine speed should not be allowed to exceed 2,500 rpm. The brakes should be applied as necessary to maintain engine speed below the 2,500 rpm level.

The transmission transmits power to both the front and rear axles through separate drive shafts. A parking brake of the internal expanding type is provided on the output shaft to the front axle.

The MB-5 is equipped with power-assisted steering. The service brakes are of the hydraulic type, and the system incorporates an air-over-hydraulic power assist unit. The volume of compressed air necessary for the operation of the brakes, windshield wiper, and various other control units is supplied from two reservoirs mounted on the chassis. A constant pressure is maintained in these reservoirs by an air compressor which is mounted to and driven by the engine. A recharging valve is provided on one of the reservoirs to facilitate air system charging from an external supply.

An auxiliary power generator set is located on the work deck area just forward of the main engine. The generator set consists of a one-cylinder air-cooled diesel engine coupled to a generator of 1,000-watt capacity. The generator supplies 115-volt, single-phase, 60-hertz current for the operation of hand power tools and accessories and also supplies direct current for battery charging. The generator set may be started from the operator's cab by means of an electrical starting motor. A duplicate set of starting switches is provided for starting at the unit. A means of manual starting is also provided.

Maintenance of the MB-5 requires the coordinated efforts of the using and supporting activities. On board aircraft carriers, the using activity is the V-1 Division of the Air Department, and the supporting activity is the Aircraft Intermediate Maintenance Department (AIMD). Within the V-1 Division, personnel of the ABH rating operate the vehicle. In addition to servicing and performing preoperational inspections, personnel of the V-1 Division are responsible for complete maintenance of the actual firefighting equipment and components. AS personnel of the AIMD are responsible for calendar inspection and major repair of the vehicle itself.

SB/TAU-2 FIREFIGHTING UNIT

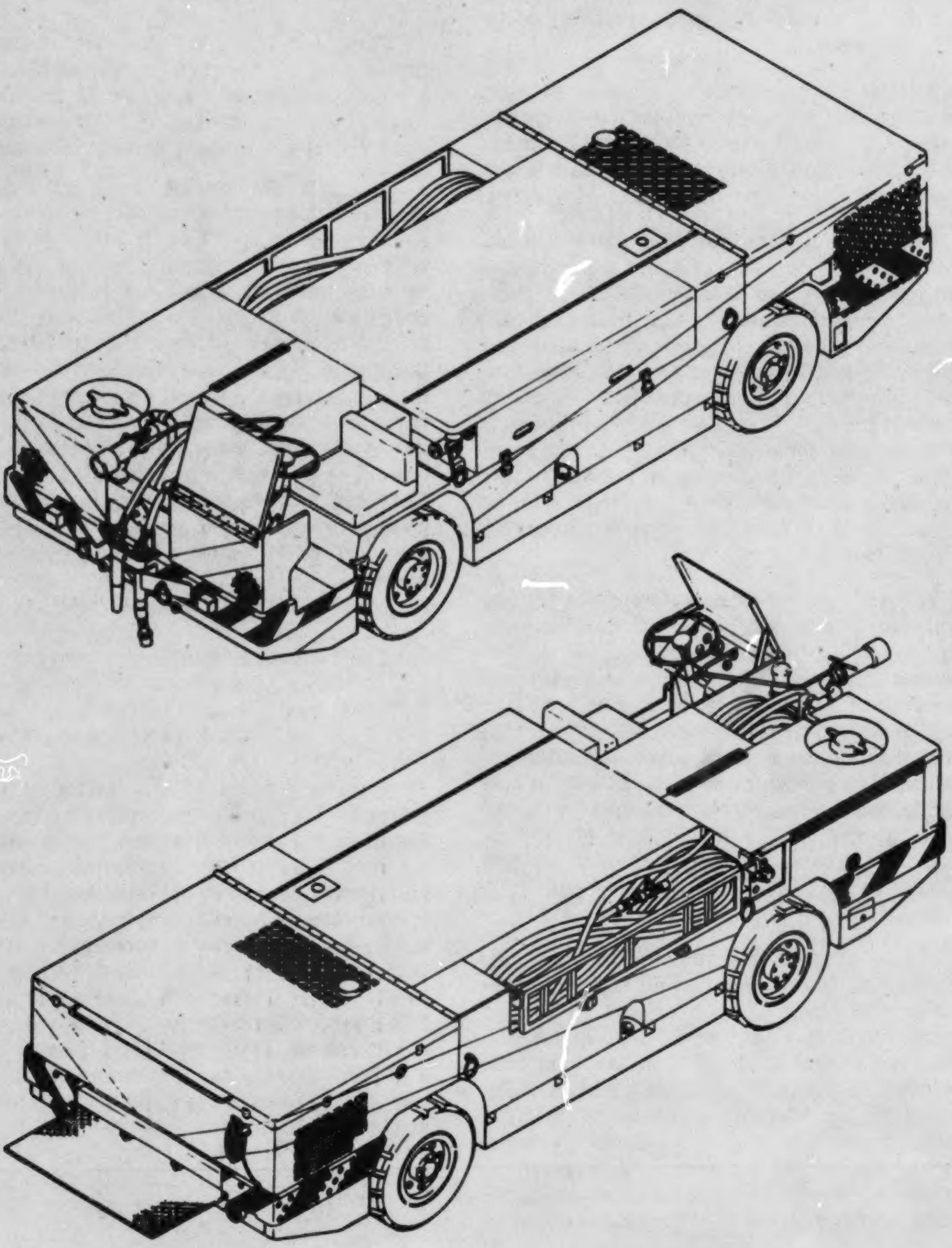
The TAU-2 is a self-contained twin agent firefighting unit designed for shipboard use. The assembly is mounted on the rear of an MD-3 tow tractor for flight deck use or it is mounted on an Aero 21C bomb skid for hangar deck use.

The TAU-2 consists of two tanks, an 80-gallon tank for premixed Aqueous Film Forming Foam (AFFF) Solution (commonly referred to as light water) and a 200-pound capacity tank for Potassium K Power (PKP) chemicals. The solutions, PKP and light water, are both propelled from the tanks through associated piping by a single 400-cubic foot capacity nitrogen cylinder. The nitrogen cylinder must have a charge of 1700 to 2400 psi at 70 degrees Fahrenheit for proper operation of the unit. The solutions are dispensed through a 100-foot noncollapsible twin hose and twin pistol grip nozzles. The hoses are bound together and enclosed by a cotton cover.

A/S 32 P-16 FIREFIGHTING TRUCK

The P-16, Type TAU 3 (see figure 6-23) is a self-propelled, low profile, firefighting vehicle designed for shipboard flight deck use. The size (40" x 65" x 175", 1/5 the size of an MB-5) and maneuverability (16'4" outside turning radius) is comparable to an MD-3 tow tractor with a rear mounted TAU-2. The capacity of the TAU-2, however, is too small to be highly effective in fighting major fires while simultaneously augmenting pilot rescue. The physical size of the MB-5 limits its access to some areas of the flight deck during flight operations, and its firefighting effectiveness is limited by its ability to expel its full capacity within 90 seconds. The MB-5 requires a basic crew of five while the P-16 requires three. The crew for the P-16 consists of a driver situated in the forward left quarter, and two handline operators stationed on a platform at the rear of the truck. The truck is powered by a two-cycle, four-cylinder, liquid-cooled Detroit Diesel Type 4-53N. The engine develops 136 bhp at 2400 rpm, with a displacement of 212 cubic inches.

The drive system used in the truck is a hydrostatic transmission system. This type of



227.115

Figure 6-23.—Firefighting truck, P-16 (A/S32P-16, Type TAU-3).

drive has the advantage of operating an automatic transmission while the engine runs at governed speed. This permits operation of the light-water pump at all times. Mechanical connections such as clutches, drive shafts, chains, etc. between the engine and the wheels are eliminated so that mounting the engine parallel to the axle is possible. One of the power take-off shafts from the engine drives a variable displacement pump supplying hydraulic power to the differential unit. The rear wheels are driven from the differential unit through universally-jointed drive shafts.

When the neutral interlock button is pushed in, the selector lever located in the driver's compartment is used for forward, neutral, or reverse. This same selector lever becomes a throttle when the neutral interlock button is pulled out. The engine can be started with the lever in the neutral position. A speed control foot pedal is mounted in the driver's compartment. The farther the foot pedal is depressed, the greater the output flow from the drive pump. When in neutral or when the foot pedal is not depressed, there is no flow from the pump to the drive motor. Switching to forward or reverse and depressing the pedal causes the truck to be driven in the selected direction. A 24-volt electrical system supplies d.c. power to the instruments, the dash-panel gauges, the solenoid controls of the hydraulic system, and to the starting and lighting systems of the truck.

The wheels of the truck are made up of two-piece bolted rims, 12 inches in diameter. All four tires are 12 ply, 7.00 x 12. The four one piece tube type tires are factory inflated with permafoam to 100 psi. A permafoam tire is a solid, foam filled, non-repairable tire.

The braking system of the truck consists of service brakes and parking brakes. The service brakes are hydraulically actuated with internal expanding drum brakes located on all four wheels. The parking brakes are actuated by a hand lever at the driver's compartment with an over-center type locking device. The hydrostatic transmission supplements the braking force required whenever forward drive is relaxed. The steering is controlled by the front wheels with the aid of a power-assist type power steering system.

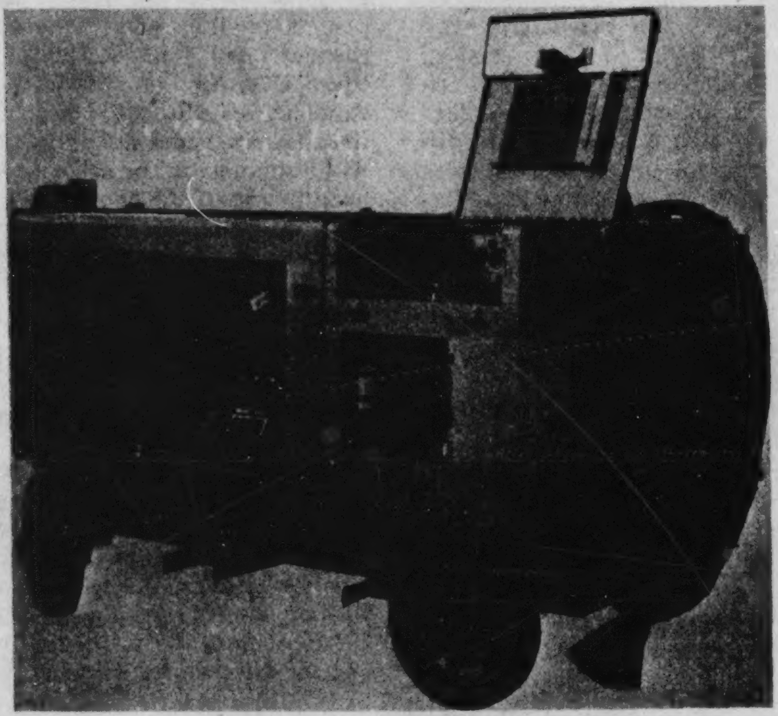
The truck contains two storage tanks which are designed to carry 375 gallons of Aqueous Film Forming Foam (AFFF) solution and 200 pounds of Potassium K Powder (PKP) dry chemical extinguisher agents. The truck is equipped with an 80-foot twinned hose handline, a single hose 100-foot handline, two fixed nozzles and a driver operated turret. The AFFF solution can be delivered through the left hand nozzle of the twinned hose handline, the single handline, and the driver operated turret. The dry chemical can only be delivered through the right hand nozzle of the twinned hose handline.

The fire-fighting system provides a dual fire-fighting capability: a light water (AFFF) system; and a dry chemical (PKP) system. The two systems operate independently of each other. However, they may be used simultaneously or they may be used to complement each other. Using one supply tank and one pump, light water can be routed to fight a fire through four separate systems: the valve and nozzle on an 80-foot twinned hose, the hand-held nozzle on a 100-foot hose, the two fixed bumper nozzles, and the driver-operated turret.

HYDRAULIC TEST STANDS

Portable hydraulic test stands provide a means of simulating the aircraft engine-driven hydraulic pump. By connecting a test stand to the aircraft's hydraulic system, the various actuating systems may be operated without turning up the aircraft engine. The test stand is connected to the aircrafts hydraulic system at ground test couplings (quick disconnects) provided on the aircraft. In addition to ground checking aircraft hydraulic systems, most test stands can be used for flushing and filling the hydraulic system with micronically filtered hydraulic fluid, MIL-H-83282 or MIL-H-5606.

Portable hydraulic test stands, such as the AHT-63 and AHT-64 (see figure 6-24), are frequently referred to as hydraulic jennys. The AHT-63 and AHT-64 hydraulic test stand is manufactured by the Sun Electric Corporation, the Liquidonics Corporation, or Vitro Services Division.



225.28

Figure 6-24.—Portable hydraulic test stand, Model AHT-64.

The AHT-63 is powered by a 50-hp, 3520-rpm, 220/440-v, 60-Hz, 3-phase, 128/64-ampere motor. It drives an axial piston-type pump which operates with a variable-volume and is pressure-compensated at 24 gpm at 3000 psi to 13 gpm at 5000 psi. The AHT-64 operates the same as the AHT-63 except it is powered by a 3-cylinder, 2 cycle Cerlist diesel engine. NOTE: The Cerlist diesel engine manufacturer (Waukesha) discontinued manufacturing the Cerlist engine and replacement parts some time ago. The test stand engines are now being replaced with a Detroit Diesel Model 3-53. The -53 series engines are used throughout the fleet in GSEs such as the NC-2A, NC-8A, NC-10A/B/C and the TAU-3 fire-fighting truck. The 3-53 engine is a member of the -53 series family of engines consisting of the in-line 3-, 4-, and the V6 cylinder configurations. These engines enjoy a high degree of interchangability of parts among members of the family.

Since the displacement (53 cu in) per cylinder is identical, 70% of the components of different engines are compatible. That is, a 4-53 engine could use 70% of the components of a 3-53 engine because they both have 53 cu in cylinders.

HYDRAULIC FLUID SERVICING EQUIPMENT

Fluid servicing is the process of adding new filtered hydraulic fluid to a system to replace fluid lost through leakage or as a result of system maintenance or malfunction. Because of the close tolerance between operating parts of equipment used in aircraft hydraulic systems, it is extremely important that precautions be taken to ensure that foreign matter is not introduced into aircraft systems. Because hydraulic fluid must not be poured directly in a hydraulic unit or aircraft system, the hydraulic servicing (dispensing) units were developed.

The only approved types of hydraulic fluid dispensing equipments for use in servicing hydraulic systems are listed in table 6-2. The use of any other servicing equipment to service hydraulic systems must be approved by the Aircraft Controlling Custodian, Naval Air Rework Facility or the Naval Air Systems Command. In all cases any and all servicing equipment must be fitted with 3-micron (absolute) filtration in the discharge line and constructed so the fluid cannot become contaminated.

HYDRAULIC FLUID SERVICING UNIT, MODEL H-250-1

The Hydraulic Servicing Unit, Model H-250-1 is a 1-gal servicing unit, illustrated in

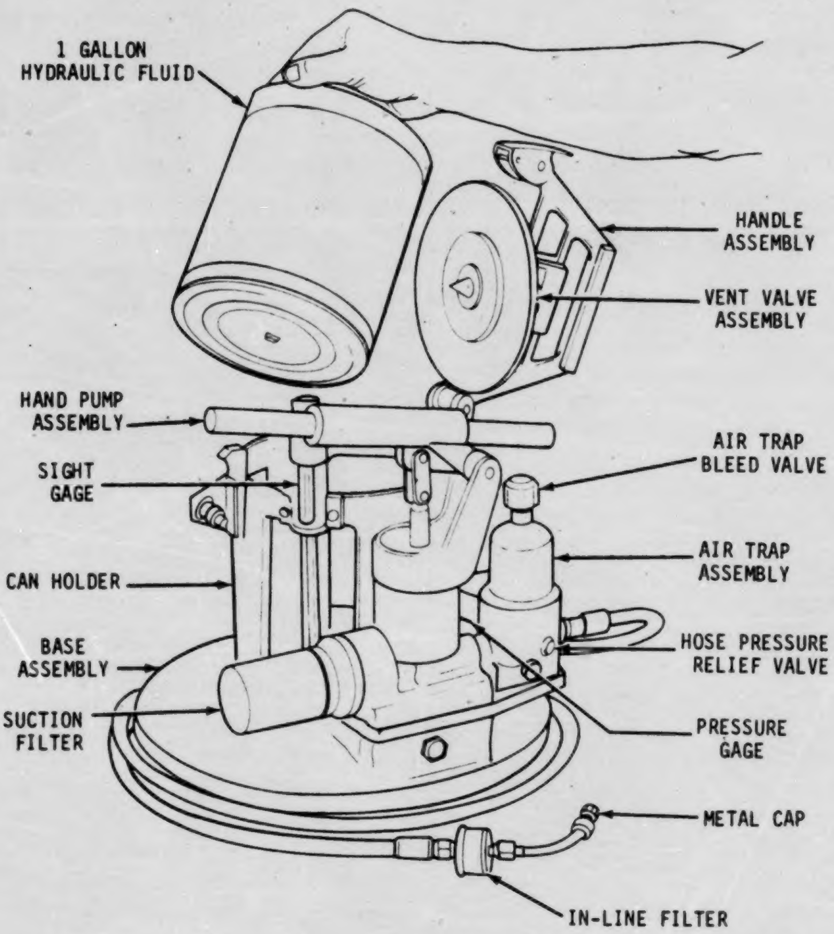
Table 6-2.—Approved hydraulic fluid dispensing equipments

NOMENCLATURE	MODEL NO.	CAPACITY
Hydraulic Fluid Servicing Unit	H-250-1	1 gal
	HSU-1	3 gal
Hydraulic Fluid Servicing Cart	310	10 gal
Hydraulic Check and Fill Stand	74	5 gal
	35-100A	5 1/4 gal
	D21929	7 1/2 gal
	718-0001	7 1/2 gal
Portable Hydraulic Test Stand*	AHT-63	
	AHT-64	
Hydraulic Fluid Dispenser	A/M27M-10	55 gal

*These equipments are intended primarily for system check and test but have approved fluid dispensing capability.

figure 6-25. This unit provides a means for servicing systems by hand pumping filtered fluid directly from the original container without exposing the fluid to open air or to other atmospheric contamination. The unit accepts the standard 1-gal container which, when installed, serves as a reservoir. Three-micron (absolute) filtration is provided to remove even the smallest particles from new fluid and to prevent contamination of the system being serviced. While contamination in new fluid is rare, it has occurred.

An important feature of the H-250-1 servicing unit is that the original fluid container serves as a reservoir which is not opened until it is placed in the unit and the handle assembly pressed into a locked position. When the handle is locked, the can is sealed into the unit cleanly piercing the top and bottom, automatically destroying the can's potential for reuse. The H-250-1 Servicing Unit is equipped with a top piercing pin which is drilled to provide the can with atmospheric venting through a 5-micron filter. It also has a check valve to minimize airborne particulate and moisture contamination. The lower piercing pin is also drilled to provide a means for the hydraulic fluid to reach the pump through a passage in the base casting and a


1 GALLON HYDRAULIC FLUID
HANDLE ASSEMBLY
VENT VALVE ASSEMBLY
HAND PUMP ASSEMBLY
SIGHT GAGE
AIR TRAP BLEED VALVE
AIR TRAP ASSEMBLY
CAN HOLDER
BASE ASSEMBLY
HOSE PRESSURE RELIEF VALVE
SUCTION FILTER
PRESSURE GAGE
METAL CAP
IN-LINE FILTER

227.116

Figure 6-25.—Insertion of can into hydraulic servicing unit H-250-1.

3-micron filter. The filter is a nonbypass type, and when it becomes loaded the unit is rendered inoperative. The filter housing is designed so that the pump will not operate if a filter element has not been installed.

A pressure shutoff and bypass valve, a pressure gage, an air trap, and a manual air bleed valve are attached directly to the pump assembly base. The air trap automatically removes any air present in the fluid at the pump chamber and retains it in a separate trap. Air collected in the trap is vented from the unit by manual operation of a spring-loaded air bleed valve.

The H-250-1 servicing unit is provided with an 8-ft service hose equipped with a 5-micron inline filter at the discharge end to prevent reverse flow contamination through the hose. Because naval aircraft use different disconnect fittings on the reservoir service inlets, no mating fittings are provided with the unit. Each activity must procure and install the disconnect fitting required for compatibility with the aircraft supported. Both male and female fitting shall be procured so that half can be installed on the hose end and half on the bracket provided. The bracket-mounted fittings provide a contamination-free means of stowing the discharge end of the service hose when the equipment is not in actual use.

HYDRAULIC FLUID SERVICE UNIT, MODEL HSU-1

Fluid Service Unit Model HSU-1 illustrated in figure 6-26, is similar in operation to the Model H-250-1, except that it has a fluid-holding capacity of 3 gal. Like the H-250-1 servicing unit, this unit also accepts a standard 1-gal container and uses it as a fluid reservoir. In addition, it contains an integral 2-gal reservoir assembly. Three-micron filtration is incorporated to ensure delivery of contamination-free fluid.

The integral 2-gal reservoir assembly is anodized cast aluminum and, along with a hand pump assembly, is mounted to a cast aluminum base. The lower can piercer shown in figure 6-26 is mounted on top of the reservoir and allows fluid to flow from the installed 1-gal container into the reservoir, automatically replenishing it. A sight gage indicates the fluid level of the reservoir. It reads from 0 to 2 gal in 1/4-gal increments. An indicated level of 2 gal or less denotes that the 1-gal container is empty and can be removed for replacement.

HYDRAULIC FLUID SERVICE CART, MODEL 310

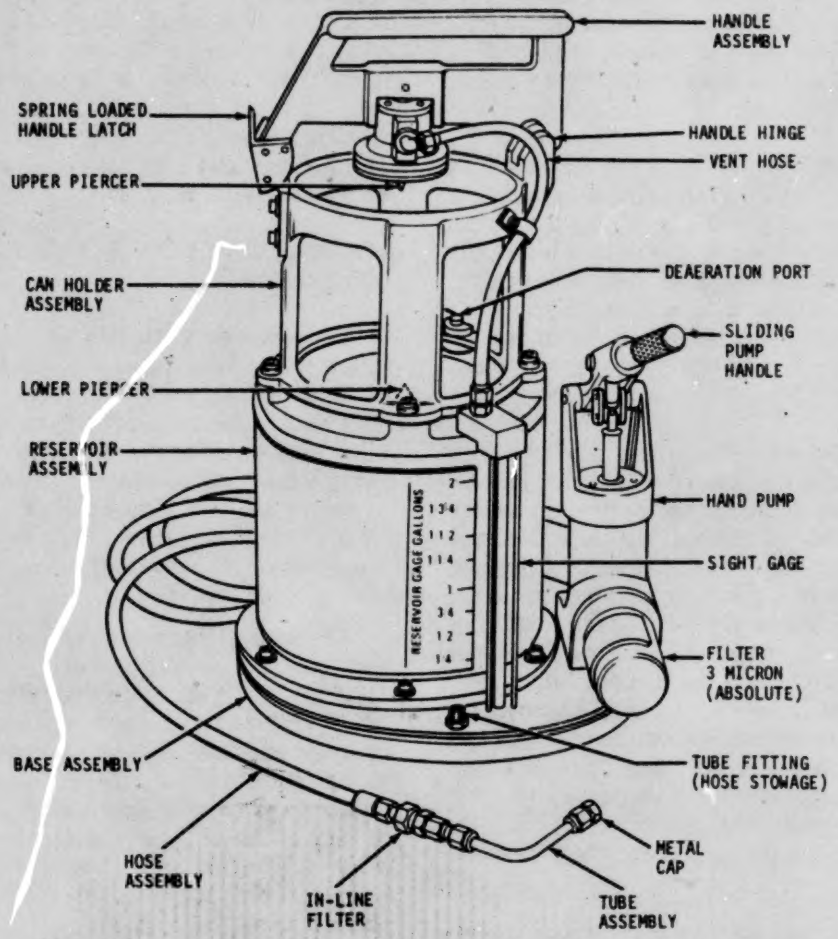
Fluid Service Cart, Model 310 illustrated in figure 6-27, is a hand-propelled mobile unit designed for servicing aircraft hydraulic systems with fluid obtained directly from the 10-gal container. It can be operated by one man and is for use in those applications where the fluid capacity of the H-250-1 servicing unit (1 gal) or HSU-1 service unit (3 gal) servicing units is inadequate. The hand pump is used to deliver 3-micron (absolute) filtered fluid.

The main frame assembly of the fluid service cart consists of a two-wheel dolly having a tubular handle extending outward to enable hand pushing or pulling of the cart. The frame contains an inner bridle which, with the cart in its upright position, may be positioned around and secured to a 10-gal fluid drum without requiring lifting of the drum. Once installed in the bridle, the drum can be readily moved about using the dolly or tilted back 90 degrees from vertical to the position required for operation.

STEAM CLEANERS

A steam cleaner (figure 6-28) serves as a compact, mobile, easily operated means of cleaning and degreasing vehicles, vehicle parts, aircraft engines, machinery, and all equipment not subject to damage by the application of moisture. Often those parts of equipment that are damaged by moisture can be covered with moisture-proof material and the equipment still be steam cleaned. The steam cleaner can also be used for sterilization, disinfecting, and paint removal.

A one-cylinder three-horsepower, air-cooled gasoline engine powers the cleaner. It has a


HANDLE ASSEMBLY
SPRING LOADED HANDLE LATCH
HANDLE HINGE
VENT HOSE
UPPER PIERCER
DEAERATION PORT
CAN HOLDER ASSEMBLY
SLIDING PUMP HANDLE
LOWER PIERCER
RESERVOIR ASSEMBLY
RESERVOIR GAGE GALLONS
2
1 3/4
1 1/2
1 1/4
1
3/4
1/2
1/4
HAND PUMP
SIGHT GAGE
FILTER 3 MICRON (ABSOLUTE)
TUBE FITTING (HOSE STOWAGE)
BASE ASSEMBLY
METAL CAP
HOSE ASSEMBLY
IN-LINE FILTER
TUBE ASSEMBLY

227.117

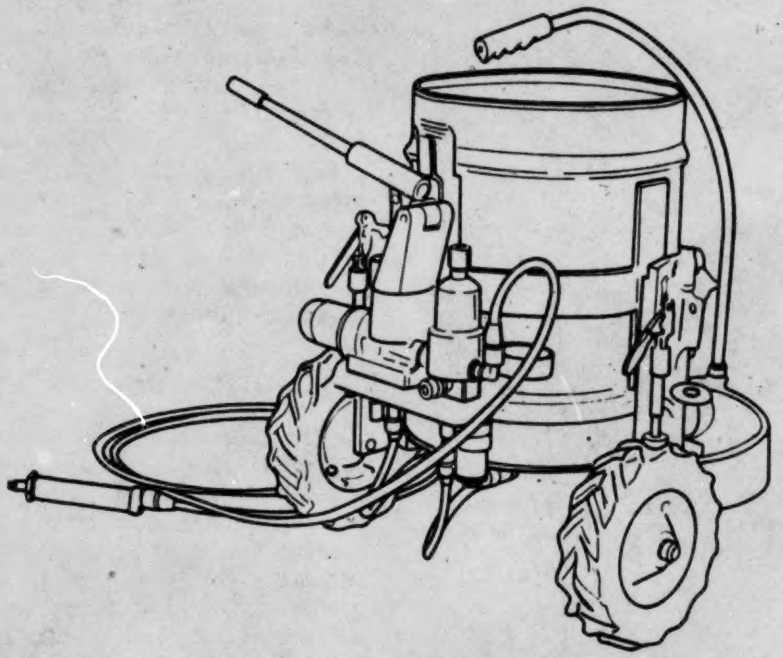
Figure 6-26.—Fluid service unit, Model HSU-1.

magneto ignition system and is similar to the engines mounted on many powered lawn mowers. It furnishes power via a V-belt arrangement to drive the two piston-type fuel and water pumps, the burner magneto, and the blower fan. A governor holds the engine speed steady during operation. A centrifugal clutch couples the engine to the V-belt drive pulley of the system. The clutch disengages the engine from the cleaner system when the engine is at idle speed, and automatically engages the engine with the system when the engine is advanced to operating speed.

The burner fuel pump pumps kerosene to the burner where it is vaporized. The burner magneto furnishes the spark to ignite and keep the kerosene burning. Cleaning compound in solution with water is pumped into the heater coil where it is brought to a high temperature. The vapor spray that is forced into the delivery hose at high pressure is a mixture of steam, water, and cleaning compound. The cleaning gun assembly, used to direct the vapor on objects to be cleaned, has an insulated handle.

HONING MACHINE

The portable dry honing machine (figure 6-29) is a compact, self-contained, lightweight

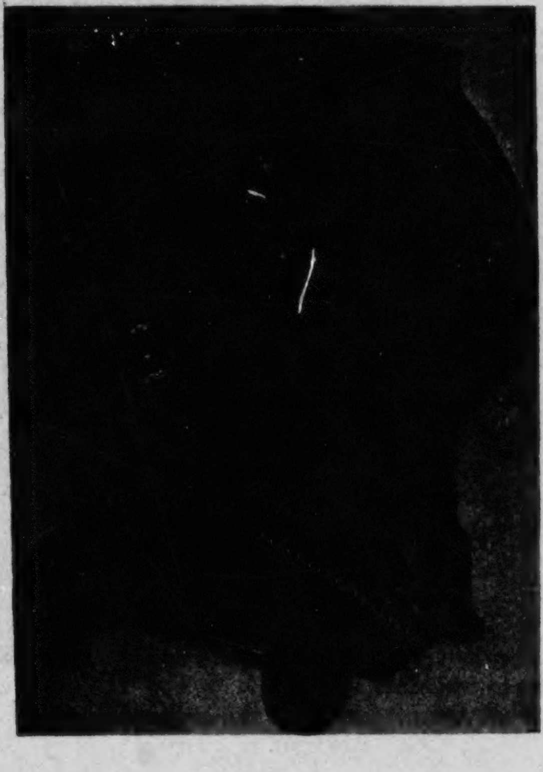


227.118

Figure 6-27.—Fluid service cart, Model 310.

227.17

Figure 6-28.—Steam cleaner.



227.59

Figure 6-29.—Dry honing machine.

(160 lb), portable unit used for cleaning small work pieces and for the safe and convenient removal of corrosion through the dry honing process. Although it is used principally for aircraft and aircraft component corrosion removal, it is equally effective on the equipment within the maintenance field of the work of the AS. The machine must have an outside source of air to operate. The abrasives are either glass beads or aluminum oxide particles. The glass beads are used on metals that will corrosively react with aluminum should aluminum oxide be used.

The blast gun assembly (figure 6-30) consists of a hand-held gun, blast control valve, nozzle assembly, and the connections for air, abrasive supply, and abrasive return hoses. The abrasive is fed into the flow of air which is then directed against the work piece. Abrasive and debris are then returned to the filter bags by an air ejector pump or an electrical pump that has been installed on some units.

To use, hold the blast gun firmly against the surface to be dry honed and press the blast control valve at the gun. Move the gun smoothly over the surface in a uniform manner. To prepare the work piece, remove all oil, water, and other debris before starting the dry honing process. To prevent loss of abrasives, the blast control valve must be released before the gun is raised from the surface.

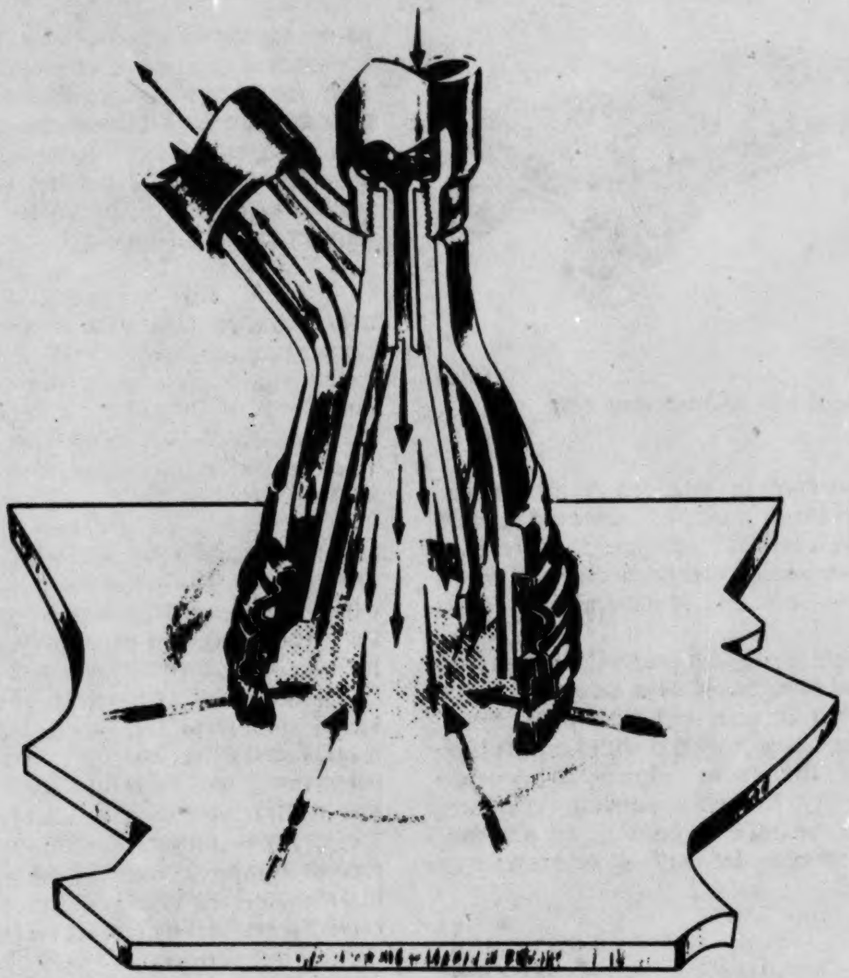
TRAILERS, DOLLIES, AND CARTS

The trailers usually found as part of aviation support equipment are special-use, unpowered, four-wheeled vehicles. They have a towing tongue, and the front wheels are turned in a manner similar to an automobile or are free swiveled. The wheels have either solid or pneumatic tires. Two or more of the wheels are usually equipped with a brake system to permit the trailer to be parked in a desired position.

Trailers are used to move ordnance, oxygen, nitrogen, and liquid oxygen (LOX). Equipments such as aircraft starters, air conditioners, engine preheaters, gas turbine compressors, and preoilers are permanently mounted on trailers. The trailer permits the mobility needed for this type of equipment without the prohibitive cost of an engine and accessories that would not be needed most of the time. Aircraft engine service trailers are used to move and support both jet and reciprocating aircraft engines when the engines are removed from the aircraft. These trailers are usually manufactured as a unit with the equipment mounted on them.

UNPOWERED DOLLIES

Unpowered truck dollies (figure 6-31) are commonly referred to as crash dollies. They are provided on all carriers for moving heavy aircraft components and to serve as aids in moving crashed aircraft. This is a heavy-duty, low-bed dolly of welded steel construction with a hard fiber top surface and four swiveled, shock absorbing, caster-type wheels with nonsparking tread. Bar rails on all four sides of the dolly provide handholds and places for tiedowns. These dollies can be modified in many different ways to serve specific purposes. One such



227.18

Figure 6-30.—Blast gun, cutaway view.

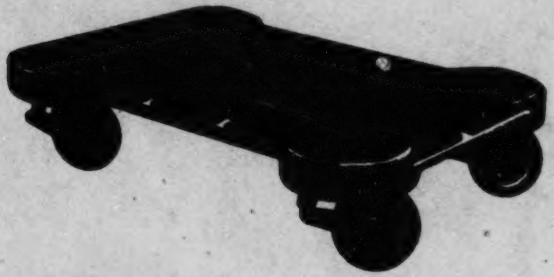
modification has a heavy steel socket welded to the top of the dolly to insert a landing gear strut when the wheel is broken off. Any modification of the dolly must be sufficiently strong to safely handle the load imposed on it. The aircraft spotting dolly is covered separately in this chapter because it is self-propelled.

CARTS

Carts are two-wheeled vehicles, often having a caster-type small wheel on a stand projecting from the tongue to keep the cart horizontal when not hitched to the towing vehicle. They are used to haul the same material or equipment as trailers, but they have smaller bulk and weight capacity.

PRESERVATION/DEPRESERVATION TRAILER

Aircraft and aircraft components, as well as support equipment, must be preserved before

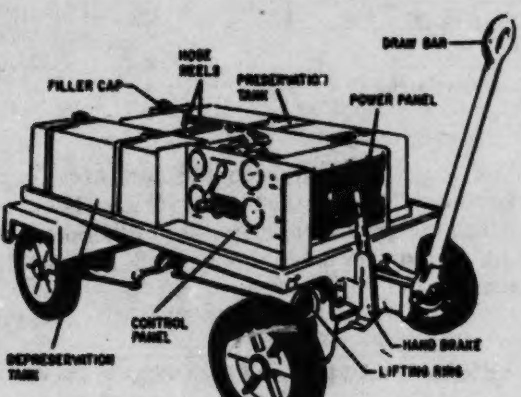


199.51

Figure 6-31.—Aircraft crash dolly.

shipment, storage, or extended repair periods. The preservation must be removed before operating the aircraft or equipment. A preservation/depreservation trailer or cart is used for this purpose. One such unit is illustrated in figure 6-32.

The chassis of this unit is of welded steel construction and so arranged as to be transportable by ship, cargo aircraft, and helicopters. Four-wheel suspension is provided with knuckle-type steering of the front wheels to provide maneuverability. Internal expanding brakes are used to hold the trailer in position when in use. A tow bar is provided with a lunette eye to permit towing by other vehicles. The enclosure is constructed to provide a nonskid working platform for maintenance personnel when servicing aircraft engines. All doors and panels are constructed to provide a weather-tight seal and are arranged so that the internal components are readily accessible by personnel for operation, adjustment, or maintenance.



225.227

Figure 6-32.—Preservation/depreservation trailer.

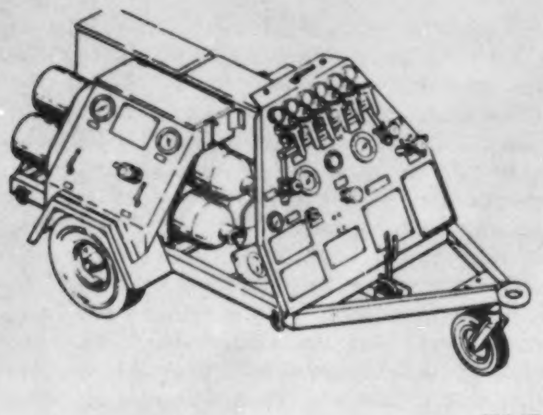
Two oil tanks are provided. An L-shaped depreservation tank with a 20-gallon working capacity is mounted on the right side of the trailer and a rectangular shaped preservation tank with a 30-gallon working capacity is mounted on the left side. Both tanks are provided with cleanout openings, drains, and filler necks.

This unit is equipped with an electrically driven pump. The pump is capable of delivering either preservation or depreservation fluids at the rate of 3 gallons per minute against a head pressure from 0 to 250 psi. A 3-phase, 3-wire, 220/440-volt, 60-hertz electrical system is provided to operate the pump motor and strip heaters and their controls. The system is so wired that it may be easily connected for operation at either voltage. The system is connected to the external power supply by means of a 3-conductor cable 35 feet long and terminating in a standard 3-prong male plug. The heaters are arranged so that they may be operated at either 200 or 440 volts. They are capable of heating the oil reservoirs from 32° to 250°F within one hour.

NITROGEN SERVICING UNIT

Nitrogen servicing units, similar to the model shown in figure 6-33 can be found at most naval air stations and on board aircraft carriers. This unit is designed to provide a mobile source of compressed nitrogen for servicing aircraft high pressure systems and inflating aircraft tires. The nitrogen servicing unit is mounted on a two-wheeled trailer with a retractable, swivel caster-type front wheel.

Compressed gas cylinders are mounted to the frame in two groups of three each. A steel box is



225.17

Figure 6-33.—Nitrogen servicing unit (NAN-3).

located between the cylinder groups for storage of hoses and necessary tools for system servicing. A tow bar is provided on the trailer to enable towing by other vehicles.

Two control panels are mounted to the frame—the main panel which provides controls for high pressure system servicing and the auxiliary panel which provides controls for aircraft tire inflating.

A chemical drier is provided to remove any moisture which may have adhered to the valves or which may have been accidentally introduced into the system. The chemical is contained in a metal cartridge or can which is changed periodically, and the nitrogen passes through the drier just before it enters the servicing hose.

NITROGEN

For all practical purposes, nitrogen is considered to be an inert gas. (Inert is defined as chemically inactive not combining with other chemicals.) It is not completely inert like helium or argon. Nitrogen is very slow to combine chemically with other elements under normal conditions. Nitrogen, as a gas, supports no fires, no living things, and causes no rust or decay of most of the things with which it comes in contact. Due to these qualitities, its use is preferred over compressed air in many pneumatic systems, especially aircraft and missile systems.

There are two classes of gaseous nitrogen and both are available in military supply. Class I is oil free—that is, it is compressed by a water lubricated or nonlubricated pump. This class is commonly referred to as water-pumped nitrogen. Class II is defined as oil tolerant nitrogen. This class is compressed with an oil lubricated pump and is, therefore, referred to as oil pumped nitrogen.

Class I (water pumped) nitrogen is most commonly used in aviation. Class II (oil pumped) nitrogen can be dangerous in certain situations. For example, if oil pumped nitrogen is used in tires, an oil film (hydrocarbon) may build up on the inside walls of the tire, soaking into the pores of the rubber. This should not hurt synthetic rubber and it does not present a combustion hazard in the presence of inert nitrogen. However, when nitrogen is not available compressed air is used to inflate the tire. The hydrocarbon film is then in contact with compressed air which is definitely a combustible mixture. The use of air is an undesirable practice.

One of the greatest potential hazards when oil pumped nitrogen is available is the possibility that someone will use it to purge an oxygen system. Oxygen will not burn, but it supports and accelerates combustion and will cause oil to burn more easily and with greater intensity. Therefore, oil-pumped nitrogen must never be used to purge oxygen systems. When the small amount of oil remaining in the nitrogen comes in contact with the oxygen, an explosion may result.

Nitrogen gas will not support life, and when released in a confined space will cause asphyxia (the loss of consciousness as a result of too little oxygen and too much carbon dioxide in the blood).

In the liquid state, nitrogen is colder than liquid oxygen. Under normal atmospheric pressure the temperature of liquid nitrogen is -320°F. Therefore, if it is exposed to air, oxygen from the air may condense into the liquid nitrogen. If exposure is allowed to continue for any length of time, the oxygen content of the liquid nitrogen increases to the point where the liquid requires the same precautions in handling as liquid oxygen.

The following safety precautions should be strictly observed for safe operation of the high-pressure and liquid nitrogen service vehicle:

1. Only qualified operators should operate the vehicle.

2. Always wear protective clothing when handling liquefied gas. Wear goggles, loose fitting leather gloves, and long sleeves when handling liquid in a container or drawing liquid from a valve.

3. Store and use liquid nitrogen in a well-ventilated place. Without adequate ventilation, expanding nitrogen lowers the oxygen content in the air. Air with low oxygen concentration causes dizziness, unconsciousness, or even death.

4. Dispose of liquid nitrogen in an outdoor area where its cold temperature cannot cause damage and where it will evaporate rapidly.

5. Do not touch supply lines without protective hand coverings. Unprotected hands will stick to the line and attempts to withdraw from it may tear the flesh.

6. Various parts of the system contain gaseous nitrogen at pressures up to 3,000 psi. The precautions and procedures that apply are the same as those for handling compressed air at the same pressures.

OXYGEN SERVICING UNITS

For aircraft servicing, oxygen is provided in one of two forms. The first is liquid oxygen, which is extremely cold, but not under any great pressure. The second is compressed oxygen, which is in a gaseous form and contained in high pressure cylinders. Different equipment is used for the different forms and examples of both types are discussed below.

OXYGEN

Aviator's breathing oxygen is supplied in two types (I and II). Type I is gaseous oxygen and type II is liquid oxygen.

Liquid oxygen, commonly referred to as LOX is normally obtained by a combined cooling and pressurization process. When the temperature of gaseous oxygen is lowered to -182 °F under about 720 psi pressure, it begins to form into a liquid. When the temperature is lowered to -297 °F, it remains a liquid under normal atmospheric pressure. Once converted into a liquid, oxygen remains in its liquid state as long as the temperature is maintained below -297 °F. The liquid has an expansion ratio of 862 to 1, which means that one volume of liquid oxygen will expand 862 times when converted to a gas at atmospheric pressure. Thus, one liter of liquid oxygen produces 862 liters of gaseous oxygen.

Liquid oxygen can be handled safely and easily by observing the following safety precautions:

1. Never allow liquid oxygen to contact the skin. The extreme low temperature of the liquid immediately freezes the area and severe frostbite results. Obtain first aid immediately if splashed with liquid oxygen.

2. Personnel who may be exposed to accidental spillage of liquid oxygen must wear protective clothing to prevent skin and vision damage because of freezing.

3. Only qualified or authorized personnel being trained and under the supervision of qualified personnel should be allowed to operate liquid oxygen equipment.

4. NO SMOKING applies at all times. Oxygen gas does not burn, but it supports combustion of any material which does burn.

5. Keep liquid oxygen away from absorbent materials, loose clothing, or rags. These materials can trap oxygen gas and later be ignited by a spark from a cigarette or match.

6. When in use, keep the equipment in a well-ventilated area away from all gasoline, kerosene, oil, or grease.

7. Never confine liquid oxygen in any piping or container. The pressure buildup when the liquid expands to gas will rupture any piping and tubing.

Liquid oxygen must be kept free of contamination otherwise serious consequences may result. A contaminated supply may cause noxious and nauseating odors which may adversely affect the pilot's efficiency or cause malfunctions in the liquid oxygen system. For these reasons, all personnel working with liquid oxygen servicing equipment should take every possible precaution to maintain the quality of the liquid oxygen supply and prevent contaminants from being introduced into the supply during the storage and transfer operations.

To prevent liquid oxygen contamination:

1. Never store liquid oxygen in or around areas in which odors of any type may be absorbed by the liquid oxygen. It should be remembered that liquid oxygen has a high affinity for (is highly attracted to and mixes readily with) many gaseous compounds. An ample of a poor storage practice is parking the liquid oxygen trailers in the area behind the flight line where jet aircraft are parked.

2. Extreme care should be taken to ensure that dirty or oily equipment is never used with liquid oxygen equipment.

3. Keep the liquid oxygen transfer hose filler valve dust cover in place at all times except when actually in use.

NOTE: This dust cover is usually attached to the hose with a chain. This ensures that the cover will be readily available at all times.

4. Liquid oxygen storage tanks and servicing trailers should never be allowed to go dry and be exposed to the atmosphere. When the liquid oxygen equipment is emptied for any reason, it should be closed to the atmosphere in order to prevent the introduction of water vapor or odor.

NOTE: Liquid oxygen storage tanks and servicing trailers which have been allowed to run dry must be purged in accordance with the existing directives.

5. Know your oxygen system completely. Make sure you know how much pressure you have in the system to be filled and in each of the cylinders before you start to add oxygen.

6. Ensure that the line valve on the discharge end of the servicing hose is closed at all times when not actually servicing a system.

7. The charging hose must never be tightly stretched to reach a connection. Position the trailer so the service hose is not under tension during a service operation.

8. When disconnecting the service hose from a fitting, loosen the connection slowly to prevent rapid bleeding of the trapped oxygen.

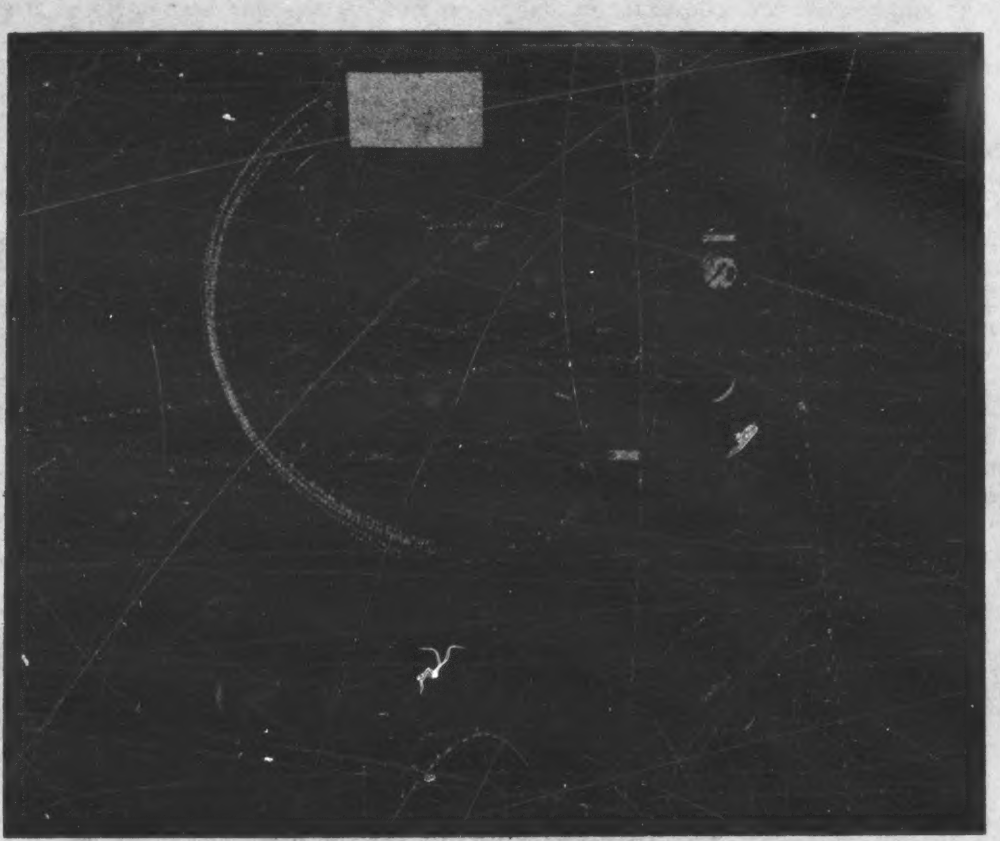
9. The trailer should be stowed inside whenever possible. Where inside storage is impractical, a canvas cover should be fabricated to protect the manifold components and service hose assembly.

LIQUID OXYGEN SERVICING TRAILER (TYPE NO 4)

The liquid oxygen servicing trailer shown in figure 6-34 is the type NO 4, manufactured by Ronan and Kunzl. It is typical of equipment currently in use with the exception of the TMU-70/M oxygen servicing trailer. The other types of liquid oxygen servicing trailers are similar in operation, but differ in tank capacity and running gear. The lower profile of some types allows them to pass under low wings of aircraft and other obstructions encountered during shipboard and line operations.

The type NO 4 servicing trailer is a 50-gallon unit. Basically, this unit consists of a liquid oxygen tank, a transfer hose assembly, and a trailer. The necessary controls are mounted in a hooded area on the rear of the tank. The hose is stowed in a rack mounted on the side of the tank.

Figure 6-35 is a schematic diagram of the liquid oxygen tank and related equipment. As shown in the diagram, the unit consists of two tanks (inner and outer), separated by an annular space which is packed with a powder-type insulating material. This space between these tanks is evacuated to a high degree (forming a vacuum like a thermos bottle). Since the vacuum bottle was invented by Sir John Dewar, this construction is called a "Dewar tank."



213.138

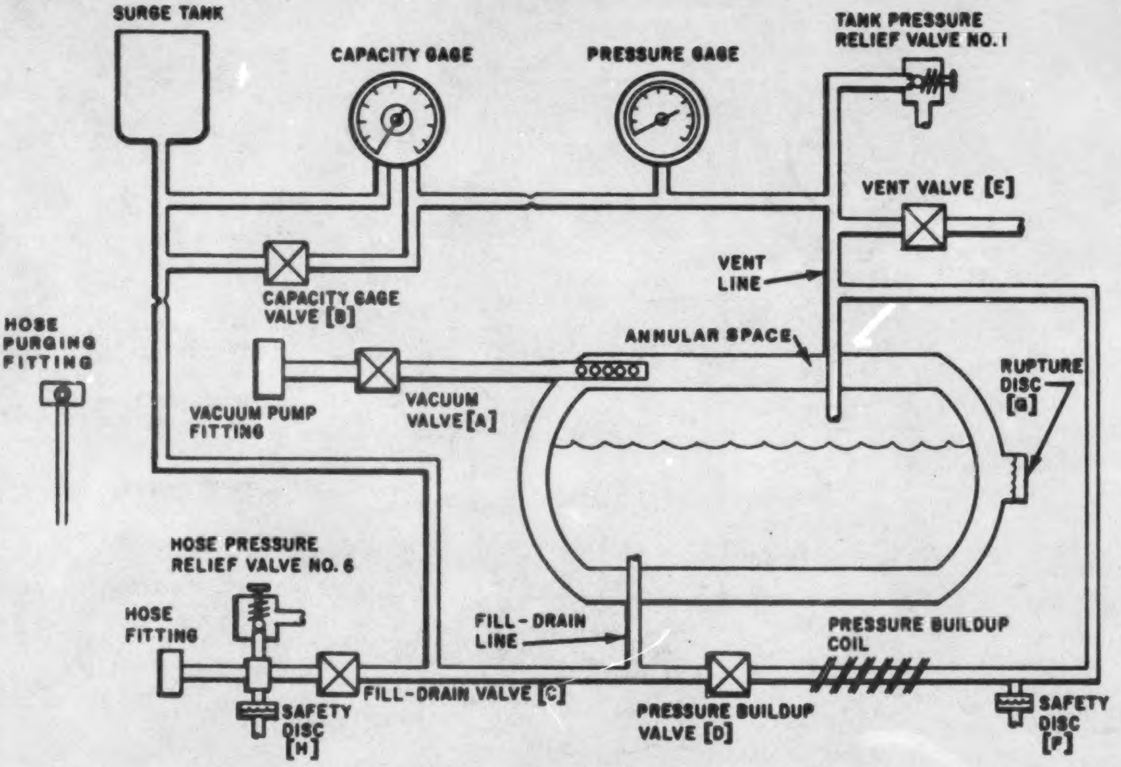
Figure 6-34.—Type NO 4 liquid oxygen servicing trailer.

The servicing trailer is equipped with all the control valves, gages, pressure relief valves, and blowout rupture discs necessary for simple and safe operation. Practically all this related equipment is located either inside the control hood or on the outside of the control hood which is attached to the rear of the tank. (See figure 6-36.)

The vent line and fill-drain line connect the inner tank to the external piping. Both lines emerge in the control hood. The pressure buildup coil, which is connected between the vent line and the fill-drain line, operates as a heat exchanger to vaporize liquid oxygen and pressurize the inner tank during the transfer of liquid oxygen.

To prevent excessive pressurization of the inner tank, the tank pressure relief valve (1) and a safety rupture disc [F] shown in figure 6-35 are installed in the pressurizing coil line. The rupture disc [G] located in a weather hood at the front of the tank, is designed to rupture and release the pressure between the inner and outer tanks in the event that the inner tank is damaged.

Two direct reading gages are shown on the control hood—a pressure gage, to indicate the pressure in the inner tank, and a differential pressure type capacity gage with a bypass valve. In addition, pull-to-test handles for the tank pressure relief valve and the hose pressure relief


SURGE TANK
CAPACITY GAGE
PRESSURE GAGE
TANK PRESSURE RELIEF VALVE NO. 1
VENT VALVE [E]
VENT LINE
CAPACITY GAGE VALVE [B]
HOSE PURGING FITTING
ANNULAR SPACE
RUPTURE DISC [G]
VACUUM PUMP FITTING
VACUUM VALVE [A]
HOSE PRESSURE RELIEF VALVE NO. 6
HOSE FITTING
FILL-DRAIN LINE
PRESSURE BUILDUP COIL
FILL-DRAIN VALVE [C]
SAFETY DISC [H]
PRESSURE BUILDUP VALVE [D]
SAFETY DISC [F]

213.139

Figure 6-35.—NO 4 liquid oxygen servicing trailer (schematic).

valve are located on the hood, as well as a fill-drain hose coupling.

The following components are located inside the control hood as shown in figure 6-35: a tank pressure relief valve (1), a vent valve [E], a fill-drain valve [C], a pressure buildup valve [D], a hose pressure relief valve (6), a hose pressure safety rupture disc [H] and a transfer hose purging fitting.

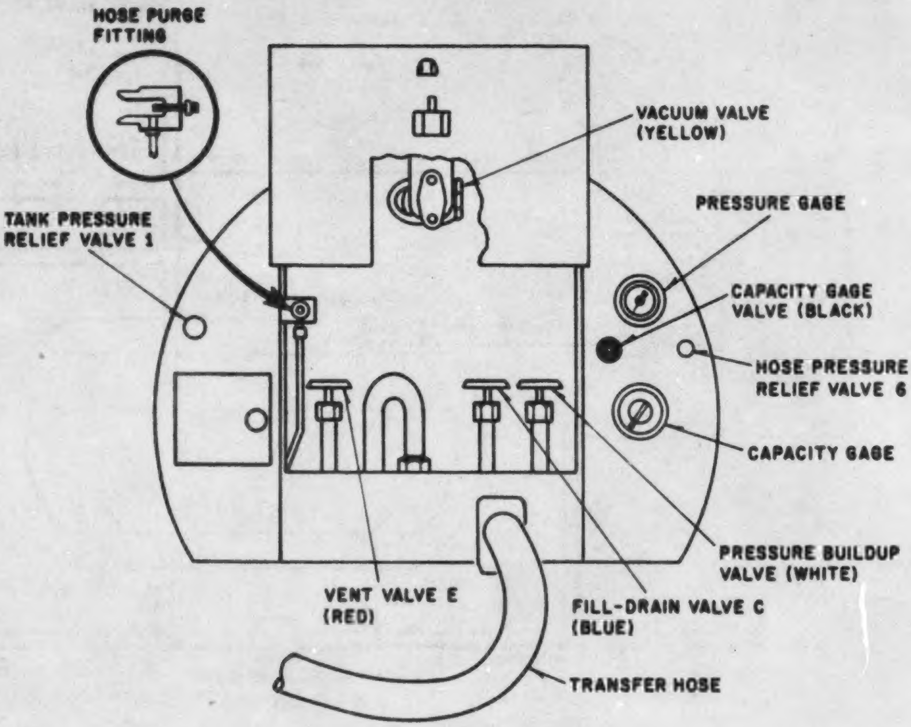
NOTE: The control valve handles shown in figure 6-36 are color coded for ready identification.

The trailer is equipped with a length of 3/8-inch inside diameter flexible hose. The hose is insulated and has a covering of braided stainless steel. One end of the hose is attached to the fill-drain coupling of the servicing trailer. The other end of the hose is equipped with a filler valve assembly. The filler valve has a dust cover which must be in place at all times when the hose is not in use.

The tank and related equipment are mounted on a four-wheel knuckle-steering utility trailer of all-steel construction. The trailer is equipped with a mechanical handbrake assembly, hoisting links, and a tow bar.

Operation

The liquid oxygen servicing trailer is used to store a supply of liquid oxygen and to fill aircraft converters. The valves mounted under the


HOSE PURGE FITTING
VACUUM VALVE (YELLOW)
PRESSURE GAGE
TANK PRESSURE RELIEF VALVE 1
CAPACITY GAGE VALVE (BLACK)
HOSE PRESSURE RELIEF VALVE 6
CAPACITY GAGE
PRESSURE BUILDUP VALVE (WHITE)
VENT VALVE E (RED)
FILL-DRAIN VALVE C (BLUE)
TRANSFER HOSE

213.140

Figure 6-36.—NO 4 liquid oxygen servicing trailer (control panel).

hood on the rear of the tank control the various functions of the trailer. Table 6-3 lists the position of the valves for each function of the trailer.

The filling, pressure buildup, transfer, and storage functions of the NO 4 liquid oxygen servicing trailer are described in the following paragraphs.

FILLING.—Servicing trailers are usually filled from large liquid oxygen storage tanks. These tanks are quite similar in construction and operation to the servicing trailer.

The first step in filling the trailer is to set the trailer control valves in the positions as indicated in table 6-3. After the control valves are set, check the trailer pressure relief valves (tank pressure and hose pressure) for freedom of operation. This is done by pulling the handles several times.

Purge the storage tank hose by allowing a little liquid oxygen to flow out of the hose.

CAUTION: To prevent fires and explosions always drain liquid oxygen into a clean drain pan or can.

After the storage tank hose has been purged, attach the hose to the servicing trailer fill-drain coupling. Open the fill-drain valve on the trailer, then open the fill-drain valve on the storage tank. The fill-drain valve on the storage tank should be opened only enough to permit partial flow until the transfer hose and servicing trailer have been cooled down. This requires about a minute and is indicated by a slowing down of the gas escaping from the vent line on the servicing trailer. Open the storage tank fill-drain valve and leave it open until the trailer is full.

Table 6-3.—Valve positions for type NO 4 trailer functions

Valve identification		Valve name	Functions					
Letter	Color		Bottom filling	Top filling	Pressure buildup	Transfer	Vacuum pumping	Liquid storage
A	Yellow	Vacuum	Closed	Closed	Closed	Closed	Open	Closed
B	Black	Capacity gage	Open	Open	Open	Open	Open	Open
C	Blue	Fill-drain	Open	Closed	Closed	Open	Closed	Closed
D	White	Pressure Buildup	Closed	Closed	Open	*Closed	Closed	Closed
E	Red	Vent	Open	Open	Closed	Closed	Open	**Open
P	Silver	Top fill	Closed	Open	Closed	Closed	Closed	Closed

* If pressure falls below desired transfer pressure, open valve "D" until desired pressure is obtained.

** Should be closed when tank is empty and not used.

NOTE: When the liquid spurts from the trailer vent line, the tank is full.

Close the fill-drain valve on the storage tank, then close the fill-drain valve on the trailer. Next, relieve the pressure in the transfer hose by pulling the hose pressure relief valve. Disconnect the transfer hose.

CAUTION: Personnel filling liquid oxygen servicing trailers must wear the special protective gloves, face shield, and clothing provided for this purpose.

WARNING: Some liquid may remain in the transfer hose even after the relief valve has been pulled. Use caution at all times when disconnecting the transfer hose. Keep it pointed away from people.

After an interval of 10 minutes (to let the liquid quiet down), the trailer should be checked (using the capacity gage) to see if the tank is full. Close the capacity gage bypass valve to allow the capacity gage to operate.

NOTE: You must reopen the capacity gage bypass valve as soon as the gage reading is taken.

PRESSURE BUILDUP.—In order to transfer liquid oxygen from the servicing trailer to an aircraft converter, the trailer tank is pressurized. This is called the pressure buildup condition. The servicing trailer is put in the buildup condition by placing the control valves in the positions shown in table 6-3.

The pressure relief valves (hose pressure and tank pressure) should be checked for freedom of operation prior to setting the buildup condition.

The pressure buildup valve (valve D which is white) should be opened slowly while observing the tank pressure gage. As noted on the trailer schematic shown in figure 6-35, opening the pressure buildup valve allows the liquid oxygen to flow into the buildup coil. This causes the liquid to evaporate, pressurizing the space above the liquid.

The pressure should not be allowed to exceed 50 psi. Most converters may be filled with a trailer pressure of 30 psi.

NOTE: When using equipment other than the Ronan and Kunzl, type NO 4, refer to the applicable manual for the operating pressure.

The pressure buildup valve should be closed when the desired pressure is reached. In order to maintain tank pressure, it may be necessary to open the pressure buildup valve as transfers are made. Transfer pressure must be maintained in order to completely empty the trailer tank. If transfer pressure is lost when the liquid in the tank has been reduced to approximately ten gallons, it may be necessary to refill the tank before pressure buildup can be reestablished.

After completing the necessary transfers and provided no further transfers are to be made in the next four hours, the vent valve (valve E which is red) should be opened to release the tank pressure. All valves should then be set for the storage condition as indicated in table 6-3. A closed vent valve on a tank in the storage condition raises the tank pressure to the point where the tank pressure relief valve opens. If the tank pressure relief valve fails, the vent line safety disc ruptures and relieves the pressure.

STORAGE.—After the filling, buildup, or transfer functions are completed, the liquid oxygen trailer should be returned to the storage condition. In this condition, the trailer controls should be set as indicated by table 6-3. This places the tank in the vented condition. If the tank is completely empty and is not to be refilled immediately, the vent valve (valve E which is painted red) should be closed.

CAUTION: When setting the tank in the various conditions, do not disturb the vacuum valve (valve A which is painted yellow). This valve is used only when pumping down the vacuum space between the tanks.

TMU 70/M, LOW LOSS, CLOSED LOOP, LIQUID OXYGEN SERVICING TRAILER

During liquid oxygen servicing of aircraft converters, considerable loss of oxygen occurs as a direct result of the manner in which the transfer is carried out. In addition to wasting oxygen, a safety hazard is created when liquid oxygen or oxygen vapors are released to the atmosphere near operating equipment and personnel. The low-loss closed loop system has been devised to greatly reduce liquid oxygen transfer losses and eliminate the safety hazards associated with venting oxygen in critical areas.

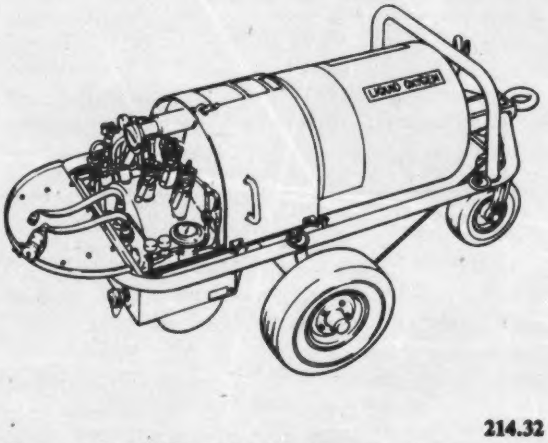
The TMU 70/M, Low Loss, Closed Loop, Liquid Oxygen Servicing Trailer is shown in figure 6-37. It is a completely self-contained unit having three major components: a 50-gallon Dewar tank, a 15-liter Dewar transfer tank, and a low loss, closed loop (LLCL) system of transfer lines. Separate liquid level and pressure gages as well as pressure relief devices are provided for each tank.

These components are permanently mounted on a portable three-wheel trailer, equipped with a manually operated parking brake and retractable caster wheel. The TMU 70/M is manufactured by Cryogenic Engineering Company.

The primary purpose of the TMU 70/M is the servicing of aircraft liquid oxygen (LOX) converters. The low loss, closed loop transfer system (LLCL) is designed to retain oxygen vapor caused by heat losses during transfer to the aircraft converter. The gaseous oxygen vapors being vented from the transfer tank and aircraft converter are returned to the storage tank for cool-down and retention.

Storage Tank

The storage tank is a 50-gallon (U.S.) capacity, double walled Dewar. The space



214.32
Figure 6-37.—TMU 70/M low loss, closed loop, liquid oxygen servicing trailer.

between the double walls of the storage tank and the transfer tank is evacuated down to five microns or lower and contains a multilayer, high vacuum insulation to minimize heat gain and boiloff of the liquid oxygen.

Transfer Tank

The 15-liter capacity transfer tank is a double walled vacuum-insulated Dewar, and permanently attached to the storage tank. It is self-contained and gravity filled from the storage tank. The transfer tank is equipped with a pressure buildup coil, relief valve, rupture disc, and controls. The primary function of the transfer tank is to hold small volumes of liquid oxygen and to utilize cold gas pressure from the pressure buildup unit for the purpose of transferring this liquid oxygen to the aircraft converter.

Transfer Lines and Piping System

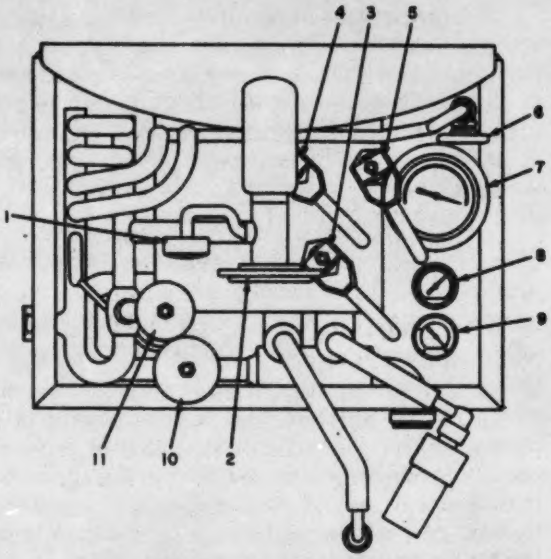
The lines carry the liquid oxygen from the storage tank to the transfer tank and then to the aircraft converter. They also carry the vented oxygen gas from the aircraft's converter to the storage tank.

The closed loop system of the transfer lines contains the vented oxygen gas during filling operations. The interconnected liquid and return gas lines are vacuum jacketed wherever practical and are of minimum length to reduce cool-down and heat leak losses.

The piping system consists of a fill line for storage tank filling, a vent system for overboard venting of excess liquid or gas, and a pressure relief valve system which is connected to the vent system.

Controls and Indicators

The controls and indicators of the TMU 70/M are illustrated and identified in figure 6-38. Storage tank pressure gage [1] indicates the pressure in the inner tank. A storage tank liquid level gage [2] indicates the level of liquid in the inner tank when the tank is on level ground. The dial is magnetically and mechanically coupled to a float sensor inside the storage tank and is calibrated in gallons. The transfer tank pressure gage [8] indicates the pressure in the transfer tank. This pressure must be more than that of the storage tank to effect transfer of liquid since the converter is vented into the storage tank during converter filling. The transfer tank liquid level gage [7] which reads in percent full, is the same type as the storage tank liquid level gage [2] that reads in gallons. Gage [9] of figure 6-38 is shown the converter full indicator gage (marked LIQUID GAS), it is a vapor pressure thermometer that monitors the converter vent line temperature.



1. **Storage tank pressure gage.**
2. **Storage tank liquid level gage.**
3. **Converter vent line shutoff valve.**
4. **Transfer tank vent line shutoff valve.**
5. **Transfer tank fill line shutoff valve.**
6. **Transfer tank pressure buildup valve.**
7. **Transfer tank liquid level gage.**
8. **Transfer tank pressure gage.**
9. **Converter full indicator gage.**
10. **Fill-drain line shutoff valve.**
11. **Storage tank vent line shutoff valve.**

214.33

Figure 6-38.—TMU 70/M liquid oxygen servicing trailer controls and indicators.

During transfer of liquid to a converter, it indicates "GAS" temperature in the converter vent line. When the converter is full the vent line is filled with liquid oxygen. The converter vent line temperature drops and the gage indicator moves to the "LIQUID" position that indicates a full converter.

With the exception of the converter full indicator gage (marked Liquid-Gas) and the transfer tank liquid level gage, all gages have a green band to indicate safe operating pressures and a red band to indicate unsafe pressures.

In addition to the indicators there are several valves in the system. The converter vent line shutoff valve [3] controls the flow of oxygen vapors from the converter to the storage tank and prevents loss of storage tank gas when the converter is not being filled. The transfer tank vent line shutoff valve [4] controls the flow of oxygen gas vapors from the transfer tank to the vapor space of the storage tank. The valve used to control the gravity flow of liquid oxygen to the transfer tank from the storage tank is the transfer fill line shutoff valve [5].

The transfer tank pressure buildup valve [6] of figure 6-38 controls the flow of liquid oxygen from the bottom of the transfer tank to the pressure buildup coil (PBU). The PBU coil is a heat exchanger which exposes the liquid oxygen to ambient temperatures which convert it to gas. As this conversion takes place, the gas expands and the output gas from the PBU is fed back to the transfer tank vapor space, providing the pressure to discharge the liquid oxygen to the converter.

The fill-drain line shutoff valve [10] is used during the storage tank filling operation. It permits the flow of liquid oxygen from a central supply tank to the storage tank. This valve is to be opened completely during the filling function and closed after the transfer has been completed.

CAUTION: The fill-drain line shutoff valve is not used to control flow. Restricting transfer flow may create a dangerous back pressure on the supply line used for filling. Control of the transfer flow should be maintained with the service valve of the central supply tank.

Storage tank vent line shutoff valve [11] is used to control the release of gaseous vapors from the storage tank to the vent piping manifold. This valve is open during filling to vent all pressure from the storage tank. During idle storage it is also left open to vent all vapors generated by normal liquid oxygen boiloff. In flight line service it is left closed to prevent oxygen vapor contact with flammable liquids or vapors and prevent unnecessary loss of liquid oxygen.

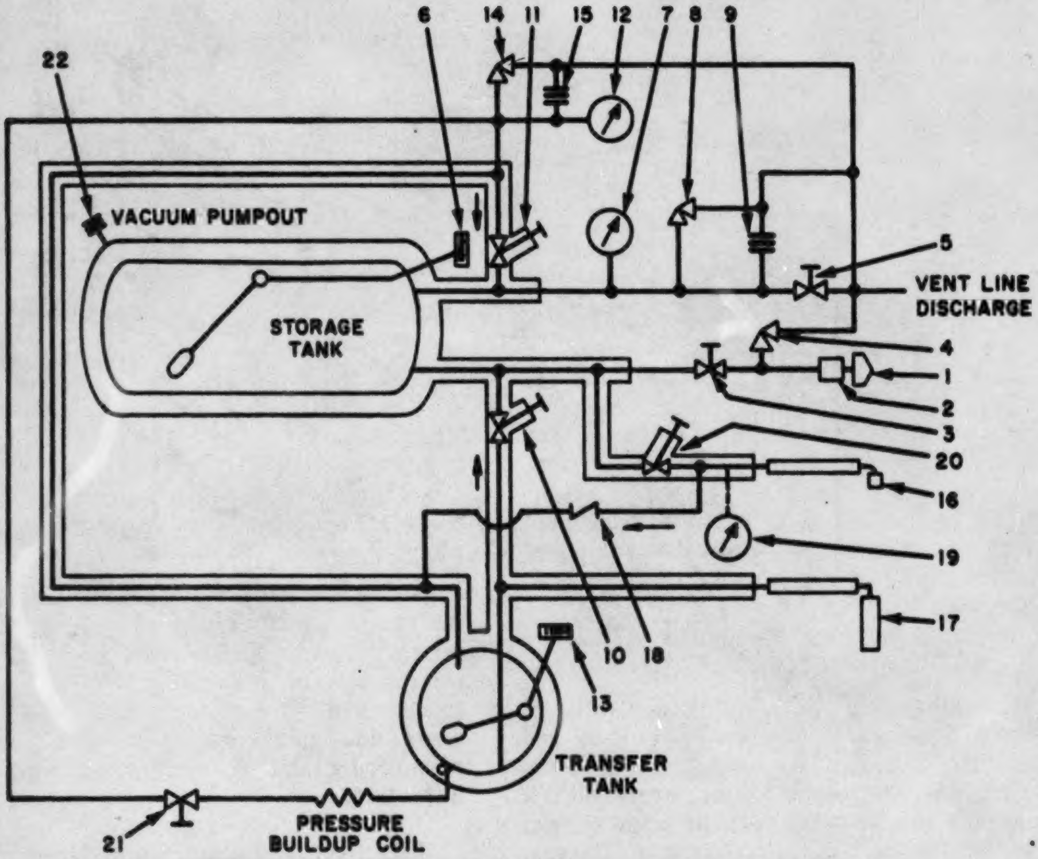
Operation

The following procedures describe liquid oxygen flow in connection with filling the TMU 70/M storage tank and the servicing of an aircraft converter using the trailer. The flow description is keyed to figure 6-39. Figure 6-40 is a copy of the actual operating instructions from the plate attached to the trailer.

When the servicing trailer is received from the factory or from an overhaul activity, it is normally ready to be filled with LOX and pressurized for immediate use. The annular space is evacuated to the point desirable for a warm and empty tank. Prior to filling or pressurizing the tank, perform a preoperational inspection.

FILLING.—Normally the servicing trailer is filled from central supply tanks. These tanks have transfer hoses terminating in couplings that match the fill-drain line coupling on the trailer. Operation of the supply tank used should be in accordance with the procedures found in its operation manual.

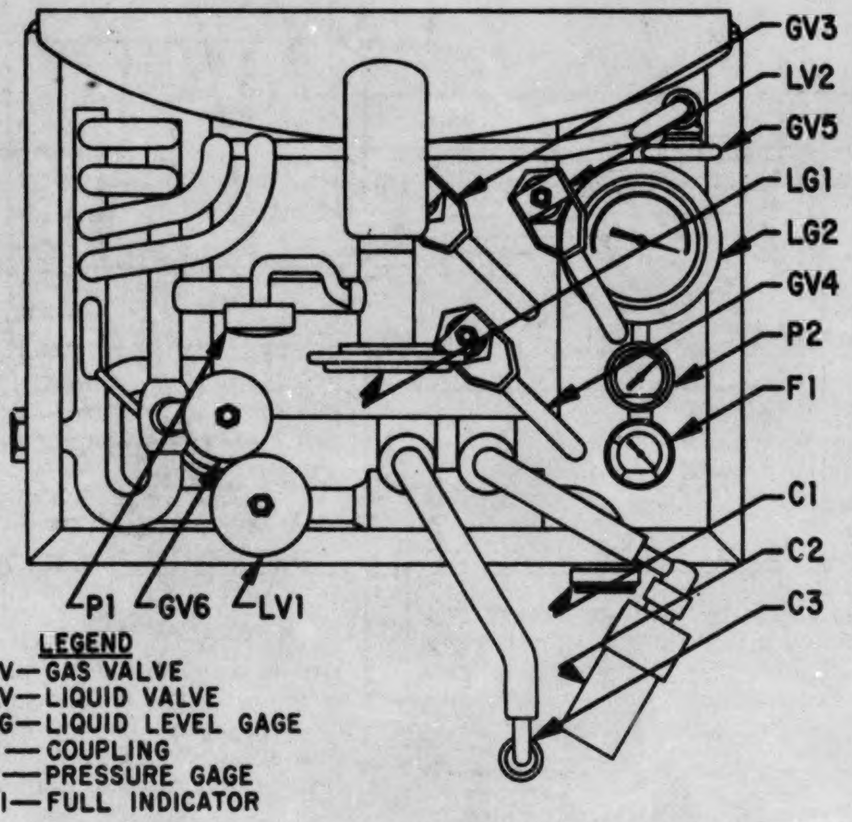
In filling the supply tank, ensure that all required safety equipment is in use and all safety precautions have been taken. Place the trailer on a level surface or ensure that the tank is level. Close all control valves on the storage tank. Pressurize the LOX supply tank to the required pressure for transfer to the TMU 70/M. Remove the dust covers from the supply tank's transfer line and purge hose. After purging, connect the fill-drain line coupling ([1], figure 6-39) to the transfer hose. Open the TMU-70/M's storage tank vent line shutoff valve [5] and fill-drain line shutoff valve [3].


6
14
11
15
12
7
8
9
22
VACUUM PUMPOUT
STORAGE TANK
5
VENT LINE DISCHARGE
4
1
2
3
20
16
19
17
10
18
13
TRANSFER TANK
21
PRESSURE BUILDUP COIL

1. Fill-drain line coupling.
2. Fill-drain line filter.
3. Fill-drain line shutoff valve.
4. Fill-drain line relief valve.
5. Storage tank vent line shutoff valve.
6. Storage tank liquid level gage.
7. Storage tank pressure gage.
8. Storage tank inner shell relief valve.
9. Storage tank inner shell rupture disc.
10. Transfer tank fill line shutoff valve.
11. Transfer tank vent line shutoff valve.
12. Transfer tank pressure gage.
13. Transfer tank liquid level gage.
14. Transfer tank inner shell relief valve.
15. Transfer tank inner shell rupture disc.
16. Converter vent line connector.
17. Air force filler valve.
18. Converter vent line check valve.
19. Converter full indicator gage.
20. Converter vent line shutoff valve.
21. Transfer tank pressure buildup valve.
22. Outer shell relief device.

214.34

Figure 6-39.—Liquid oxygen storage tank schematic diagram.



LEGEND

GV—GAS VALVE
LV—LIQUID VALVE
LG—LIQUID LEVEL GAGE
C—COUPLING
P—PRESSURE GAGE
FI—FULL INDICATOR

CLOSE ALL VALVES BEFORE STARTING ANY OPERATIONS

FILL MAIN TANK

1. CONNECT C1 TO SUPPLY TANK
2. OPEN GV6 & LV1 & OBSERVE LG1
3. WHEN TANK IS FULL CLOSE LV1 & DISCONNECT C1

FILL TRANSFER TANK

1. OPEN LV2 & GV3 & OBSERVE LG2
2. WHEN TANK IS FULL CLOSE LV2 & GV3

EMPTY TRANSFER TANK

1. OPEN GV5 & LV2 & OBSERVE LG2
2. WHEN TANK IS EMPTY CLOSE LV2 & GV5

FILL CONVERTER

1. FILL TRANSFER TANK
2. OPEN GV5 & OBSERVE P2 PRESSURIZE 80-100 PSIG
3. CONNECT C3 & C2 TO CONVERTER
4. OPEN GV4 & OBSERVE F1
5. WHEN F1 INDICATES LIQUID DISCONNECT C2
6. CLOSE GV4 & DISCONNECT C3
7. CLOSE GV5

214.35

Figure 6-40.—Operating instructions for TMU-70/M.

CAUTION: Pressure should not be allowed to rise above 55 psig in the storage tank. Monitor the storage tank pressure gage [7] closely during cool-down.

Open the service valve on the supply tank slowly and allow only a partial flow of LOX through the transfer hose and into the trailer. Considerable vaporization takes place while the transfer hose, fill-drain line, and storage tank on the trailer are cooling down. When they are sufficiently cooled and able to handle a full flow of LOX, open the service valve on the supply tank completely.

During filling, LOX flow is through filter [2] and shutoff valve [3] to the storage tank. Relief valve [4] is provided to prevent excessive pressure if the fill-drain line shutoff valve and the service valve on the supply tank are closed with cold gas or liquid trapped within the supply line.

The relief valve [4] is connected to the vent line for safe discharge overboard. Vent valve [5] is opened during filling and normal storage where safe overboard discharge is provided. Storage tank conditions are monitored and indicated by the liquid level gage [6] and pressure gage [7].

Relief valve [8] and rupture disc [9] are provided in case of excessive pressure in the storage tank of the TMU 70/M. Monitor the storage tank liquid level gage [6] during filling. When it indicates 50 gallons or LOX starts to flow out the vent manifold, close the service valve on the supply tank. Close the fill-drain line shutoff valve [3] and relieve internal pressure in the transfer hose.

CAUTION: Use extreme caution when disconnecting the transfer hose. Even though the hose has been drained and the pressure relieved, some LOX still remains. Do not direct the hose toward personnel or to other equipment.

Disconnect the supply tank transfer hose, immediately drain the LOX that remains, and replace the coupling cap loosely. Tighten the cap after ensuring that all LOX has vaporized and bled off. Close all control valves on the service trailer except the storage tank vent shutoff valve [5].

NOTE: Observe the time required to fill the TMU 70/M. Filling varies with each supply tank and supply line system. Under normal conditions and 30 psig transfer pressure, the storage tank should be filled within a period of five to ten minutes. Abnormal deviation from the average filling time should be investigated.

GASEOUS OXYGEN SERVICING TRAILERS

There are several different models of gaseous oxygen servicing trailers currently in use by naval activities. They are all similar in operation. Type NO 2, manufactured by Aeroil Products Incorporated, is the only one described here. The general appearance of the trailer is illustrated in figure 6-41.

Components

PRESSURE REGULATORS.—The pressure regulator controls the charging pressure when the trailer is being used to service aircraft oxygen systems. Only one pressure regulator is used during operation. A spare is provided to ensure uninterrupted operation should one fail.

When the shutoff valves on the inlet and outlet sides of the regulator are open, the pressure regulator is ready for use. By turning the regulator control handle cockwise, the pressure (as read on the gage attached to the regulator) increases. Turning the control handle counter-clockwise decreases pressure.

MANIFOLD CONTROL VALVES.—There are six manifold control valves which serve to shut off the flow of oxygen from the cylinders to the system being charged. These valves are lever-type valves. The manifold control valves should not be used for long time storage. Always use the handwheel-type valves located on the cylinders.

SHUTOFF VALVES.—There are four shutoff valves—one on the inlet side of each

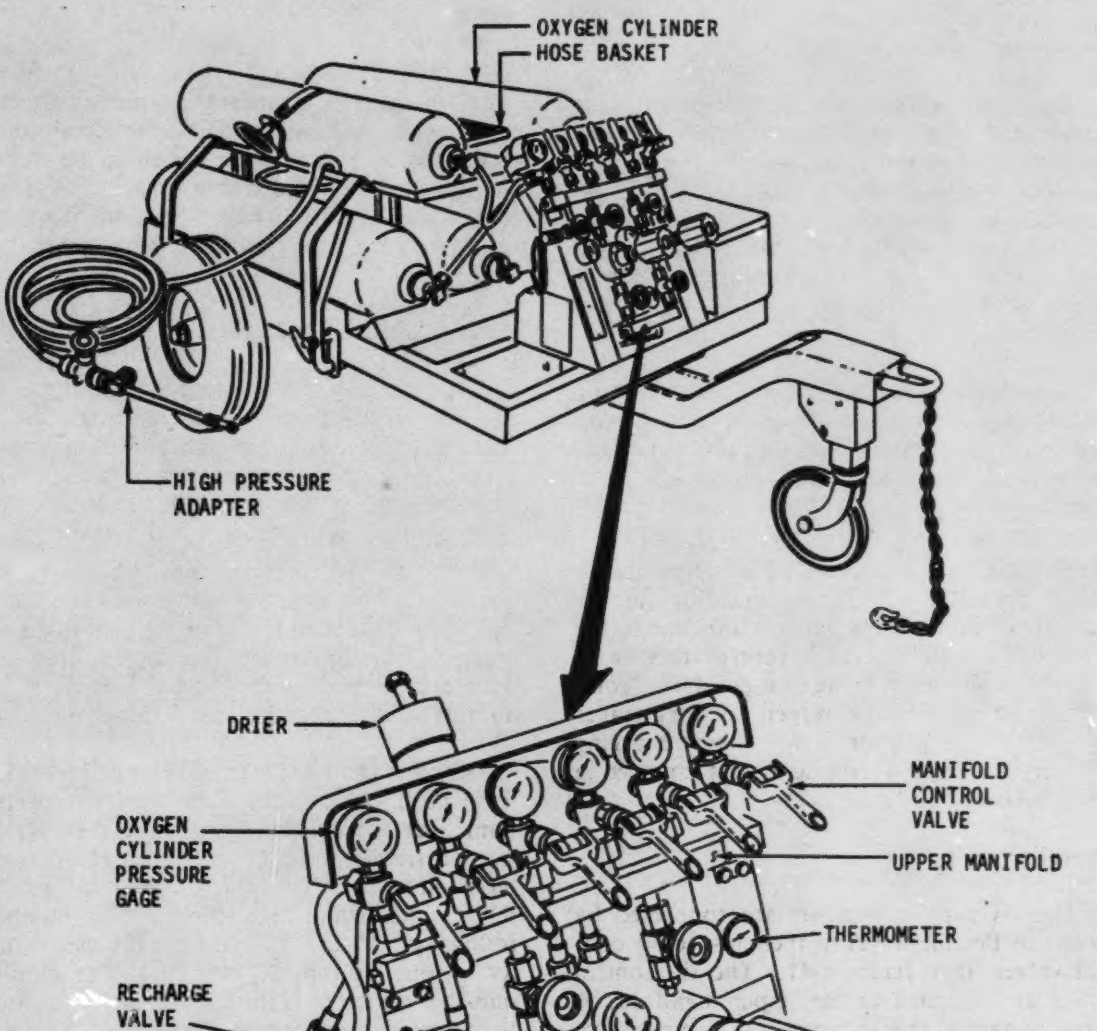

OXYGEN CYLINDER
HOSE BASKET
HIGH PRESSURE ADAPTER
DRIER
MANIFOLD CONTROL VALVE
OXYGEN CYLINDER PRESSURE GAGE
UPPER MANIFOLD
THERMOMETER
RECHARGE VALVE
PRESSURE REGULATOR VALVE
PRESSURE REGULATOR
SHUTOFF VALVE
LOWER MANIFOLD
TABLE OF FILLING PRESSURE
213.130

Figure 6-41.—Type NO 2 gaseous oxygen servicing trailer.

pressure regulator and one on the outlet side of each regulator. These shutoff valves control the flow of oxygen from the upper manifold to the lower manifold via the regulator.

DRIER ASSEMBLY.—The drier assembly is a reservoir containing a chemical drying agent through which the oxygen must pass before going through the servicing hose. This chemical drier is provided to remove any moisture in the oxygen supply. The oxygen flows into the bottom of the drier, passes up through the drying agent, and out through the servicing hose.

RECHARGE VALVE.—The recharge valve is provided as a means of recharging the trailer cylinders directly through the upper manifold without the necessity of removing the cylinders. When not in use, the valve adapter should be fitted with a dust cap.

SERVICING HOSE.—The servicing hose is a high-pressure, nonkinking, metallic flexible hose. The line servicing valve is attached to the servicing hose and is used to control the flow of oxygen to the system being charged. Other components of the gaseous oxygen servicing trailer are either a high- or low-pressure charging adapter, six oxygen cylinders, and connecting flexible hoses (see figure 6-41).

Operation

The six supply cylinders are connected by means of flexible hoses to their respective control valves. (See figure 6-41.) The six control valves are attached to the upper manifold. A pressure gage is screwed into each control valve at a point below the seat. This allows each cylinder pressure to be easily read.

The oxygen flows from the upper manifold through either of two pressure regulators through two shutoff valves. The oxygen is collected in the lower manifold where a gage registers the pressure of the delivery side of the system. The lower manifold is connected by flexible hose to a drier which filters and dries the oxygen. The servicing hose connects directly to the drier and has a line servicing valve on the terminal end. The line servicing valve is fitted with a standard oxygen cylinder connection.

MECHANICAL SUPPORT EQUIPMENT

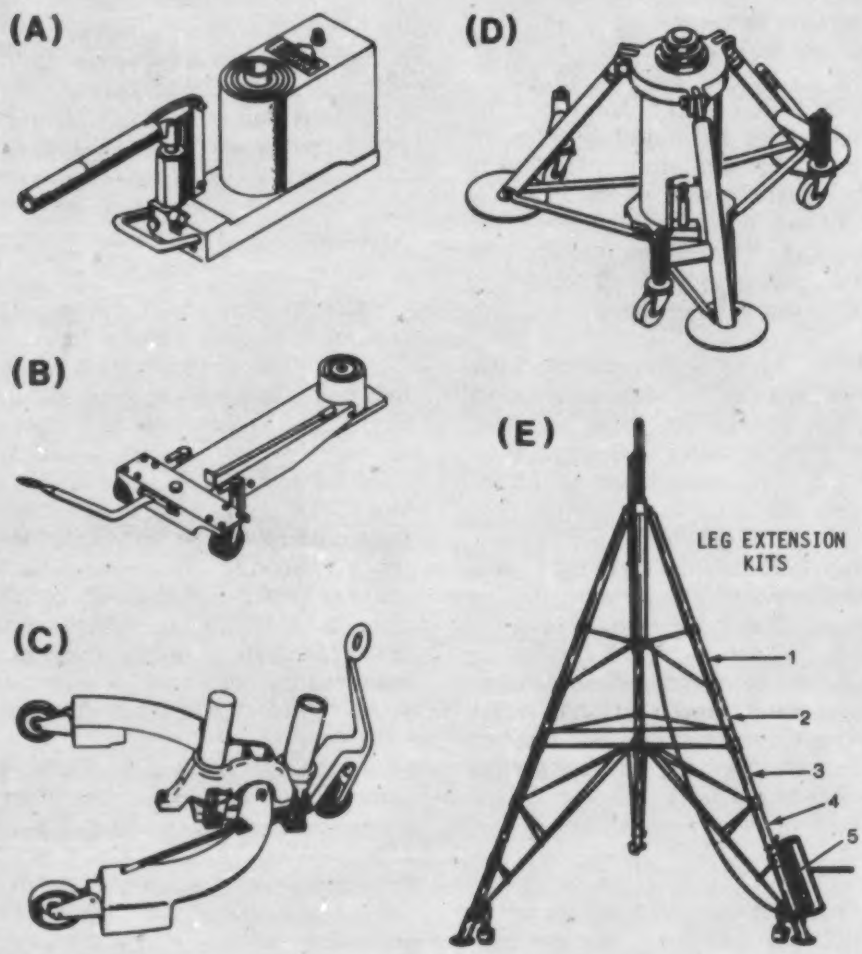
Some of the mechanical support equipment with which the AS is concerned consists of jacks, adjustable aircraft maintenance platforms (workstands), and other equipment for lifting, towing, and securing aircraft.

AIRCRAFT JACKS

Aircraft jacks are used when a complete aircraft or when only a part of an aircraft is to be lifted so that various maintenance operations may be performed. There are two basic types of aircraft jacks—axle jacks and tripod jacks. They are portable, self-contained, and hydraulically-operated units. Axle jacks shown in (A), (B), and (C) of figure 6-42, are used for raising the main landing wheels or nose landing wheel off the ground for maintenance such as wheel change. Tripod jacks, shown as (D) and (E) in figure 6-42, are used for raising the complete aircraft for maintenance. This enables aircraft maintenance personnel to raise and lower the aircraft landing gear for maintenance purposes.

Aircraft jacks are identified by an identification code which describes their respective numerical capacities (tonnage) and their type—axle or tripod. (Refer to table 6-4.) The first letter is either an "A" which stands for axle or "T" which stands for tripod. The numbers following "A" or "T" indicates the jack capacity in tons (10-ton, 20-ton, etc.). The number plus the hyphen (-) is the specific jack identification number assigned to each jack. NAVAIR publication 19-70-46 lists each jack and its identification number and also gives the jacking point at which the jack can be used on the aircraft. The aircraft jacking point codes are also listed in table 6-4.

The two letters which follow the identification number indicates the configuration of the jack (hand-carried, horseshoe, T-Bar, etc.). The last number is used only for variable height jacks and indicates the number of leg extension kits available. Note that the tripod jack in (E) of figure 6-42 has five leg extension kits.



226.48

Figure 6-42.—Hydraulic jacks. (A) Hand axle jack, (B) Alligator axle jack, (C) Crocodile axle jack, (D) Fixed height tripod jack, (E) Variable height tripod jack.

WORKSTANDS

The adjustable aircraft maintenance platform (figure 6-43) is a hydraulically operated platform and ladder assembly mounted on a caster-equipped base, which enable personnel to work in safety at heights varying from a minimum of 3 feet to a maximum of seven feet. All four wheels have locks to make the platform stationary. Other workstands are often fabricated locally to permit repair of one type of aircraft.

AIRCRAFT TOW BARS

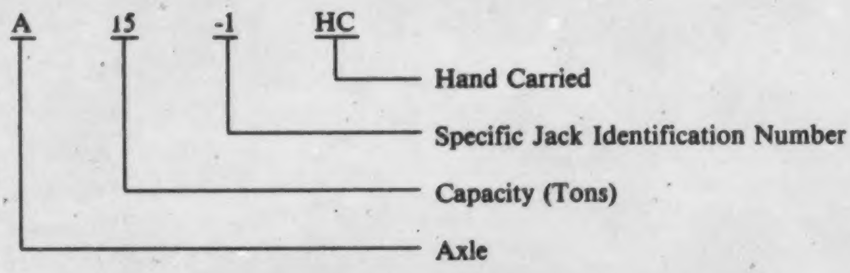
Two general classes of tow bars are used in naval aviation—those adaptable to only one type of aircraft and those adaptable to more than one type of aircraft. Most naval aircraft may be towed with the Universal Aircraft Tow

Table 6-4.—Aircraft jack identification codes; aircraft jacking point codes

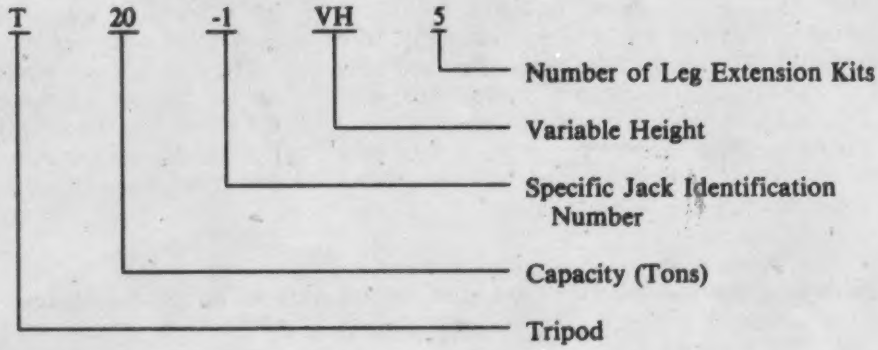
Configuration Code Identification

A = Axle
T = Tripod
HC = Hand Carried
HS = Horseshoe
TB = T-Bar
OR = Outrigger
FH = Fixed Height
VH = Variable Height

Examples: Model A15-1HC


A
15
-1
HC
Hand Carried
Specific Jack Identification Number
Capacity (Tons)
Axle

Model T20-1VH5


T
20
-1
VH
5
Number of Leg Extension Kits
Variable Height
Specific Jack Identification Number
Capacity (Tons)
Tripod

AIRCRAFT JACKING POINT CODES

MG = Main Landing Gear
NG = Nose Landing Gear
TW = Tail Wheel
WR = Wing Root
AF = Aft Fuselage
FF = Forward Fuselage
OR = Outrigger (AV-8A/B)

P = Prime
A = Alternate
EXER = Exercising Jack
K = Kit, Leg Extension

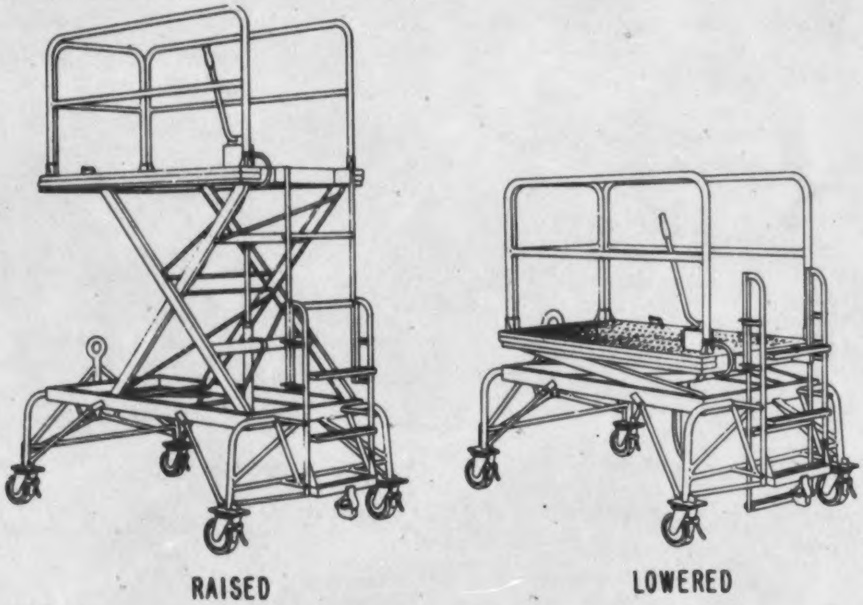


Figure 6-43.—Adjustable aircraft maintenance platform.

Bar, Model NT-4, shown in figure 6-44. The tubing of this tow bar is aluminum alloy. The tow hitch plate, end hooks used in forward towing, and the pins that fit into the hollow axle of the tailwheel and nosewheel are steel. The aluminum wheel well casting is bushed to take the towing pins when changing from nosewheel to tailwheel towing and vice versa.

For forward towing of aircraft not having a nosewheel, the end hooks of the tow bar are placed through the main landing gear towing rings. The hooks are held in place by spring-loaded lockpins. When towing aft from the hollow axle of the tailwheel, the towing pins on the wheel well casting are placed in the tailwheel axle on each side. They are then clamped in place by a chain that slides through a sleeve and is tensioned by turning a knob. A similar procedure is used in towing certain aircraft from the nosewheel, however, the towing pins are removed from the wheel wells and reversed. On other aircraft the end hooks of the tow bar are placed through the towing rings of the nosewheel and locked in place by the spring-loaded lockpins provided for this purpose.

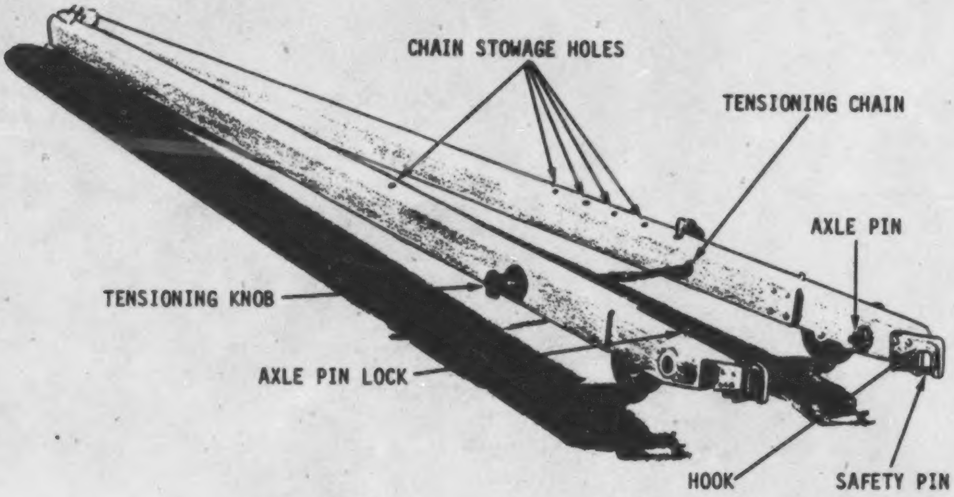
Certain aircraft may be satisfactorily towed only by the use of a tow bar designed specifically for them. For the proper use of such tow bars, consult the manufacturer's instructions for that particular aircraft.

CHOCKS

The Navy universal wheel chock (Model MWC-2) is used to immobilize aircraft aboard carriers and to some extent on shore stations. (See figure 6-45.) This is an all-metal chock that is adjustable to fit landing gear wheels up to 45 inches in diameter. Other types of chocks are used ashore and are usually made of wood locally. Wooden chocks are generally being replaced by chocks made of other materials.

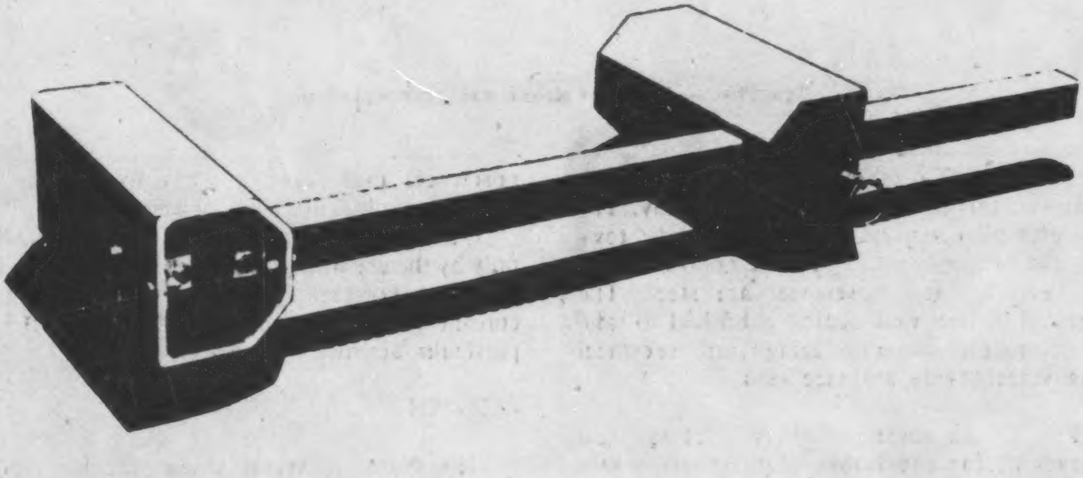
TIEDOWNS

The TD-1A all-purpose tiedown (figure 6-46) is the most commonly used by the Navy for


CHAIN STOWAGE HOLES
TENSIONING CHAIN
AXLE PIN
TENSIONING KNOB
AXLE PIN LOCK
HOOK
SAFETY PIN

199.18.1

Figure 6-44.—Universal front and rear tow bar.

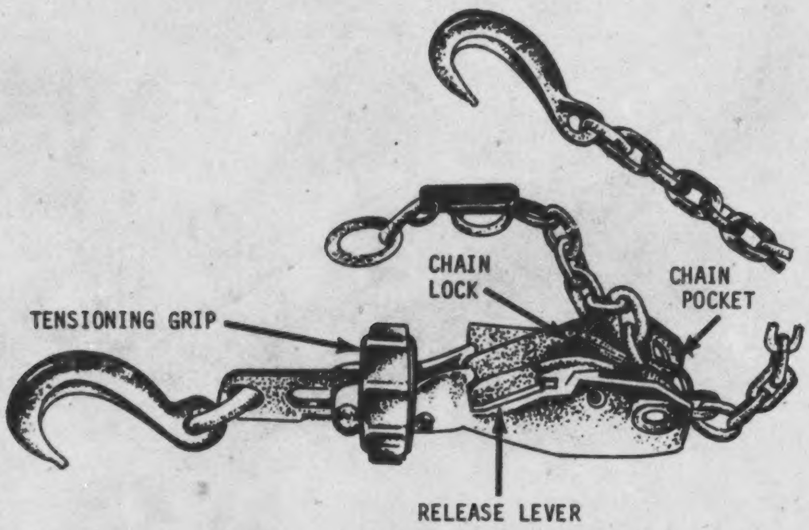


199.14.1

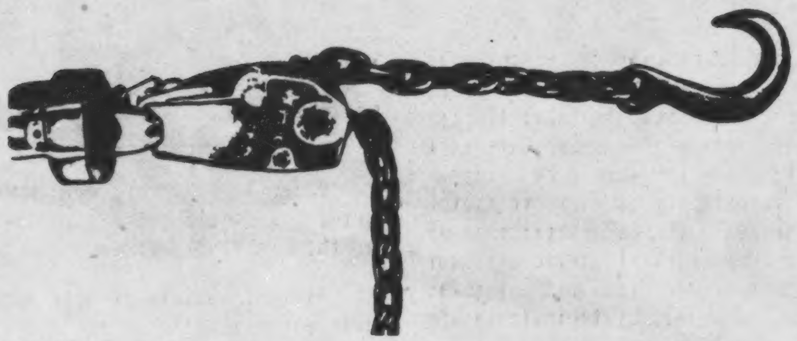
Figure 6-45.—Universal wheel chock.

securing parked aircraft and ground support equipment. The ease and speed with which it can be attached to or removed from aircraft and equipment make it most desirable during flight operations aboard carriers when time is vital.

In [A] of figure 6-46 is illustrated the correct placement and relationship of the chain in the tiedown head. The axis of the chain/hook assembly is in alignment with the centerline of the head. In this position, the TD-1A (which has a 10,000-pound rated working capacity) would fail at a load of 16,000 pounds. Incorrect installation is shown in [B] of figure 6-46. The chain/hook assembly does NOT pull in line with



A. CORRECT



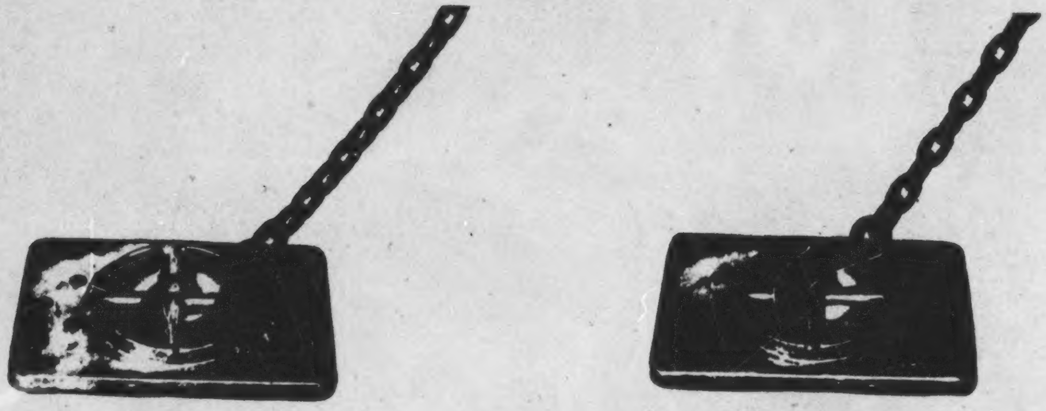
B. INCORRECT

199.16.1

Figure 6-46.—TD-1A tiedown chain installation. (A) Correct, (B) Incorrect.

the centerline of the head. Destructive pull test data shows that with the chain in this improper position, failure occurs at loads ranging from 4,200 to 6,850 pounds—with failure occurring at the serrated chain locking arm (chainlock). From these figures, you can note that improper chain installation reduces the tiedown holding strength by two-thirds of its former strength. This is an excellent reason to ensure that appropriate care is taken in assembling this tiedown.

Another common error in the use of the TD-1A is incorrectly placing the chain hook into the padeye securing point. As shown in [A] of figure 6-47, the hook should be inserted with the point UP, verses the incorrect insertion as shown in [B] of figure 6-47. When properly installed, considerably more slack in the chain is required before the hook accidentally becomes disengaged from the padeye.



A. CORRECT

B. INCORRECT

227.119

Figure 6-47.—TD-1A hook installation. (A) Correct, (B) Incorrect.

GENERAL SAFETY GROUND SUPPORT EQUIPMENT

Safety around aviation support equipment is largely a matter of common sense and not being in too big a hurry. Time must be taken to perform the required safety measures. Common sense dictates what measures should be taken to make working around aviation support equipment as safe as possible. The full cooperation of all personnel working with and around aviation support equipment is required and constant vigilance must be maintained to eliminate unsafe practices.

Safety requires that all personnel must strictly observe all safety precautions applicable to their work. You and all workers concerned should report to the supervisor any unsafe condition, material, or equipment; warn others who appear to be endangered by hazards or by failure to observe safety precautions; and report any injury or evidence of impaired health that occurs to you or to others. Each worker should wear or use protective clothing or equipment prescribed for the safe performance of the work being done. When a hazardous condition occurs, each person should exercise as much caution as is possible under the existing conditions.

Some of the safety measures that should be used around aviation support equipment are covered in the following paragraphs.

When stopping self-propelled equipment, set the handbrake or chock the vehicle. This should be done to towed equipment before unhooking.

When mobile equipment is hand pushed or pulled, it should be done only when the engine of the vehicle is stopped.

Aboard aircraft carriers, any aviation support equipment that is not in use is tied down to prevent it from becoming a hazard to personnel or equipment due to tight turning or tilting of the ship. All equipment should be as clean as possible to prevent accumulation of fuel, oil, hydraulic fluid, or grease from becoming a fire hazard or causing slippage by those working with or on the equipment.

Each piece of aviation support equipment should be used only for the purpose for which it was manufactured, except in an emergency. It should be used only by authorized personnel. The authorization should be in writing and indicate that the holder has been thoroughly checked out in the operation of the equipment and the safety practices associated with it.

Chapter 7

TOOLS AND TEST EQUIPMENT

Skilled (AS) technicians can be identified by the way they handle and care for their tools and test equipment. Tools and test equipment are costly investments. They should receive the best of care and be used to the best advantage.

There is certainly something good about a tool or a piece of test equipment that helps the average technician turn out better than average work. Better job performance alone more than supports the slightly higher cost of quality tools and test equipment.

Even more important is the fact that low quality equipment fails more easily and can result in injury to the user or damage to the equipment being repaired. However, proper use of quality equipment can improve the quality of any maintenance task and thereby reduce the possibility of failure. One of the primary duties of all maintenance personnel is to be thoroughly familiar with the tools and test equipment of their trade and to be proficient in the care and use of this equipment.

AS TOOLS

As an AS, you are only as good as you are proficient with the tools of your trade. Without tools and equipment with which to work, even the most experienced AS is rendered ineffective.

Each AS in the work center is usually issued a "worker's toolbox" of common or basic handtools. It is your responsibility to keep your tools in good condition and ready for use. At the time of issue of the toolbox, you are usually provided with a copy of a tool inventory by which you can quickly check to see if your toolbox is complete.

Special tools for which an AS has only occasional use are kept in a central place from which you may draw as needed; but frequently-used special tools may be kept in your toolbox, if practical and if there is sufficient quantity to permit it.

It becomes evident there is much you need to know about procurement, issue, care, and accounting for common and special tools as well as how to use them to perform repair and maintenance functions on aviation support equipment.

COMMON HANDTOOLS

In this chapter the term "common handtools" is used to refer to small, portable power tools and nonpowered handtools that are common to the AS; this term includes such common tools as screwdrivers, pliers, wrenches, hammers, chisels, hacksaws, files, drills, sanders, etc. These tools are given outstanding coverage in *Basic Handtools*, NAVPERS 10085 (Chapter 2), and *Airman*, NAVPERS 10307 (Chapter 10); therefore, they are not discussed in this manual.

ASE HANDTOOLS

Most of the handtools normally issued to the AS are covered in this section. These tools are classified as cutting tools, turning tools, striking tools, holding tools, and miscellaneous use handtools.

SPECIAL TOOLS

The AS uses many special tools that are not described in *Basic Handtools*, NAVPERS 10085

(Chapter 2), and *Airman*, NAVPERS 10307 (Chapter 10). A wide variety of special tools are furnished by the manufacturers of the support equipment, engines, and related equipment. These special tools are listed in the "Allowance List Registers" published by the Aviation Supply office; their use is explained in the manual that covers the specific support equipment, engine, or item of equipment for which they were designed.

Although the following paragraphs are not complete, they are descriptive of the special tools and test equipment most commonly used by the AS in maintenance work.

CUSTODY OF TOOLS

The AS who has custody of a toolbox must prevent the loss of the tools or the toolbox through neglect or misuse. Although handtools are normally classified as consumable items, they are expensive and must be paid for when lost or damaged. OPNAVINST 4790.2 (Series) outlines the policies and procedures for control of handtools. Usually, your activity will have a local Maintenance Instruction (MI) concerning the inventory interval and methods for reporting lost or damaged tools.

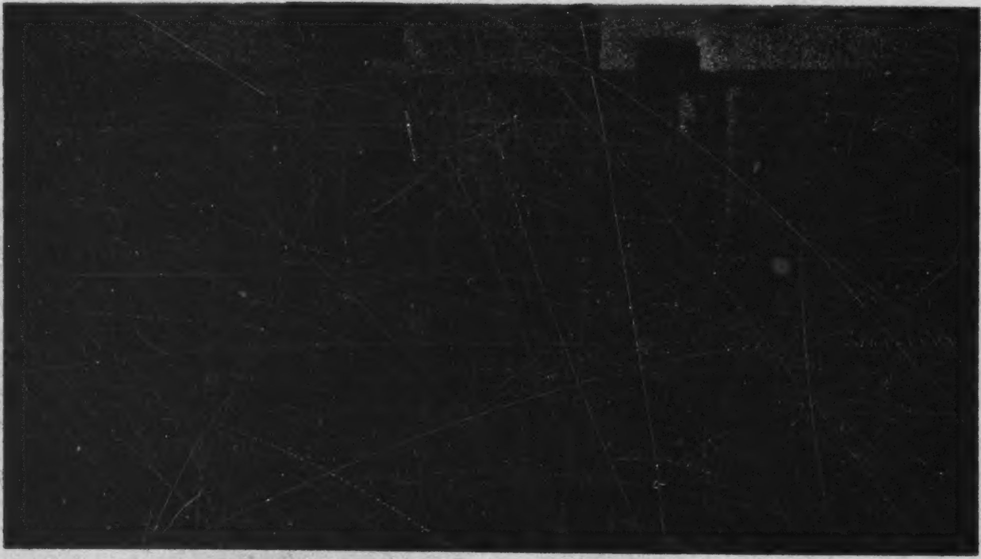
TOOLBOXES

The toolboxes shown in figures 7-1 and 7-2 are the types normally used by the AS to stow tools. Your current set of tools is likely to include only those needed most often in doing your assigned work. The tools you use should be organized in the box by type and size, and those needed often placed where they can be reached most easily. Keep your tools straight, and "extras" such as parts, pieces of "junk," and other spare items, kept out of the box.

NOTE: Broken or damaged tools can damage equipment, hardware, and parts. They can also cause personal injury to the worker and/or others. Your workcenter supervisor is responsible for ensuring that all tools are

227.91

Figure 7-1.—Basic toolbox.



227.92

Figure 7-2.—Standard issue toolbox.

properly marked as to organization, workcenter, and toolbox, and that all toolboxes are properly numbered. Furthermore, the supervisor is responsible for ensuring that an inventory is conducted at the beginning, just prior to securing each shift and prior to any planned work stoppage or equipment operation. These inventories help to prevent possible "Foreign Object Damage" (FOD). This inventory may be conducted by your crew supervisor work leader and the results submitted to your workcenter supervisor.

Upon completion of a job, you are responsible for making the proper tool annotation on the upper left corner, on copy #1, of the Maintenance Action Form (MAF). You must also conduct a proper inventory of your toolbox.

If a tool is missing, you must submit a missing tool report, notify your branch division officer, and conduct an immediate search of the area. If the tool cannot be found, your maintenance officer shall be advised, and his representative shall cause an investigation to be made. This investigation shall be to a depth necessary to assure that the missing tool cannot cause FOD to a component or other equipment.

A padlock is issued with each toolbox. Your toolbox should be kept locked and stowed in the designated area.

CUTTING TOOLS

DIAGONAL PLIERS

Diagonal cutting pliers are an important tool for the AS. They are used for cutting small wire and cotter pins, etc. Since they are small they should not be used to cut large wire or heavy material because the pliers will be damaged by such use and then not be effective to cut what they were designed to cut. They can also be used to remove small cotter pins where a new pin is to be used when the work is finished. This is done by gripping the pin near the hinge of the pliers and lifting up on the handles, releasing the pin, getting a new grip, and repeating until the pin is removed.

The inner jaw surface is a diagonal straight cutting edge offset approximately 15 degrees which permits cutting objects flush with the surface. The diagonal cutting pliers are not designed to hold objects since to use enough force to hold an object the pliers will cut or deform the object. The sizes of the diagonal pliers are indicated by the overall length of the pliers.

FILES

The AS toolbox should include an assortment of files. They are used for cutting, smoothing, or removing small amounts of metal, and are made of hardened high-carbon-content steel. Adequate coverage on the selection, care, and use of files is contained in *Tools and Their Uses*, NAVPERS 10085 (Chapter 1) and is therefore not repeated here.

HACKSAWS

A hacksaw is used primarily for sawing metal. There are two different kinds of hacksaw frames; one has a pistol-grip handle; the other has a straight handle. Most hacksaws are adjustable to take blades of various lengths. *Tools and Their Uses*, NAVPERS 10085 (Chapter 2) describes and illustrates the principles involved in selecting the most suitable blade for different types of work and gives coverage on the use and care of hacksaws.

TURNING TOOLS

SOCKET WRENCHES

The socket wrench is one of the most versatile wrenches in the toolbox. Basically, it consists of a handle and a socket-type wrench which can be attached to that handle. A complete socket wrench set consists of several types of handles along with bar extensions, universals, adapters, and a variety of sockets. (See figure 7-3.)

Sockets

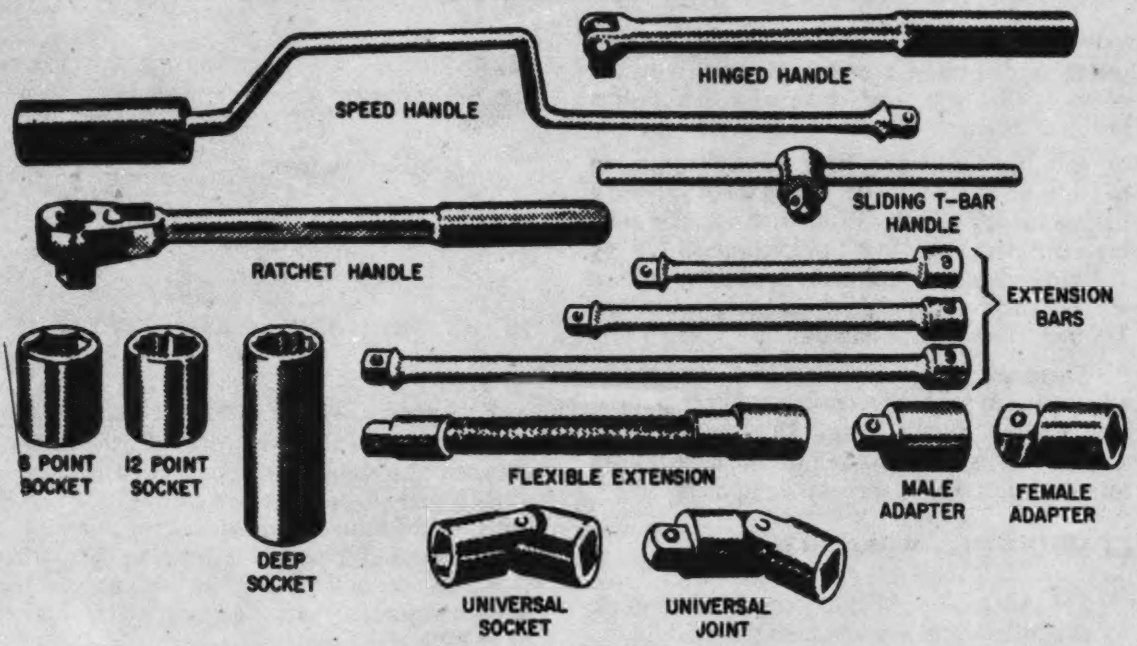
A socket has an opening cut in one end to fit a drive on a detachable handle. The handle drive is usually square. In the other end of the socket is a 6-point or 12-point opening very much like the opening in the box end wrench. The 12-point socket needs to be swung only half as far as the 6-point socket before it may be lifted and fitted on the nut for a new grip. It can therefore be used in closer quarters where there is less room to move the handle. Most sockets have 12 points. However, the 6-point socket has its use with nuts made of stainless steel, which are made of harder metal than that of the wrench. Extensive use of a 12-point socket on such nuts or bolts would cause excessive wear on the 12-points so that the socket might fail to hold. By contrast, because of the greater holding surface, a 6-point socket holds the stainless steel nut better, offering less chance for wear of the wrench.

Sockets are classified for size according to two factors. One is the drive size or square opening which fits on the square drive of the handle. The other is the size of the opening in the opposite end, which fits the nut or bolt. The standard mechanic toolbox is usually outfitted with sockets that have 1/4- and 3/8-inch-square drivers. The openings that fit onto the bolt or nut are graduated in 1/16-inch sizes. Sockets are also made in deep lengths to fit over spark plugs and long bolt ends.

There are four types of handles used with these sockets (see figure 7-3). Each type has special advantages, and the good mechanic chooses the one best suited to the job at hand. The square driving lug on the socket wrench handles has a spring-loaded ball that fits into a recess in the socket receptacle and holds the assembly together. This mated ball-recess feature prevents the parts of the wrench from falling apart during normal usage, but a slight pull disassembles any wrench connection.

Ratchet Handle

The ratchet handle has a reversing lever which operates a pawl (or dog) inside the head of the tool. Pulling the handle in one direction


HINGED HANDLE
SPEED HANDLE
SLIDING T-BAR HANDLE
RATCHET HANDLE
EXTENSION BARS
6 POINT SOCKET
12 POINT SOCKET
DEEP SOCKET
FLEXIBLE EXTENSION
MALE ADAPTER
FEMALE ADAPTER
UNIVERSAL SOCKET
UNIVERSAL JOINT

44.3

Figure 7-3.—Typical Socket wrench set.

causes the pawl to engage in the ratchet teeth and to turn the socket. Moving in the opposite direction causes the pawl to slide over the teeth, permitting the handle to back up without moving the socket. This allows rapid turning of the nut or bolt after each partial turn of the handle. With the reversing lever in one position, the handle can be used for tightening. In the other position, it can be used for loosening.

Hinged Handle

The hinged handle is also very convenient. To loosen a tight nut, swing the handle at right angles to the socket. This gives the greatest possible leverage. After loosening the nut to the point where it turns easily, move the handle into the vertical position and then turn the handle with the fingers.

Sliding T-Bar Handle

While using the sliding bar on T-handle, the head can be positioned at either the end or the center of the sliding bar. Select the position which is needed for the job at hand.

Speed Handle

The speed handle is worked like the woodworker's brace. After the nuts are first loosened with the sliding bar handle or the ratchet handle, the speed handle will help remove the nuts in a hurry. In many instances the speed handle is not strong enough to be used for breaking loose or tightening. The speed socket wrench should be used carefully, to avoid damaging the nut threads.

Accessories

To complete the socket wrench set, there are several accessory items. Extension bars of different lengths are made to extend the handles to any length needed. A universal joint allows the nut be turned with the wrench handle at an angle. A universal socket is also available, and universal socket joints, bar extensions, and universal sockets in combination with appropriate handles makes it possible to form a variety of tools that will reach otherwise inaccessible nuts and bolts.

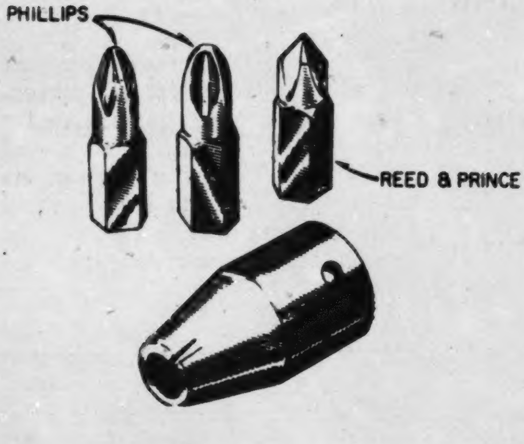
Another accessory item which comes in handy is an adapter which allows the AS to use a handle having one size drive with a socket having a different size drive. For example, a 3/8- by 1/4-inch adapter would make it possible to turn all 1/4-inch square drive sockets with any 3/8-inch square drive handle.

There are special sockets which are used to adapt various types of screwdriver bits to a speed handle (see figure 7-4). This socket type screwdriver is used to remove recessed head screws from access panels on equipment

COMBINATION WRENCHES

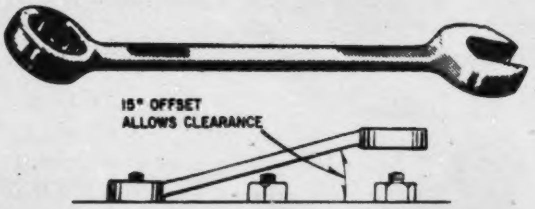
The AS toolbox should contain a complete set of combination wrenches. As shown in figure 7-5, the combination wrench has an open-end wrench on one end and a box-end (of the same size) of the other end. For speed and light stress operations, use the open-end; then switch to the box-end for safety under stress. For ease of explanation, each end of the wrench will be discussed separately.

The box-end fits completely around the nut or bolthead. The box-end is usually constructed with 12 points. The advantage of the 12-point construction is that the wrench will operate between obstructions where space for the swing angle is limited. A very short swing of the handle will turn the nut far enough to allow the wrench to be lifted and the next set of points to be fitted to the corners of the nut. It is possible to use this wrench in places where the swing angle is limited to as little as 30 degrees.



215.2

Figure 7-4.—Screwdriver adapter.



1.16.3

Figure 7-5.—Combination wrench.

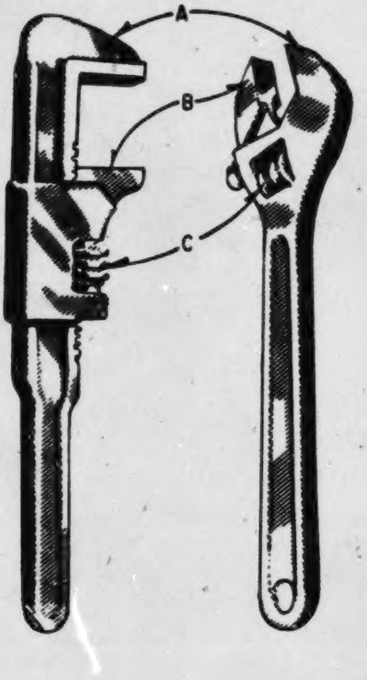
The box-end portion of the wrench is designed with an offset in the handle. Notice in figure 7-5 how the 15 degrees offset will allow clearance over nearby parts. One of the best features of the box-end is that there is little or no chance of a wrench slipping off the nut or bolt. However, there is the disadvantage of slow work with the box-end of the combination wrench. Each time the wrench is backed off, the wrench has to be lifted up and refitted to the head of the work. Therefore, to save time, use the nonslip box-end of the wrench to break loose tight bolts or to snug up work after the bolt has been seated with a faster type wrench which might slip under stress.

The jaws of the open-end portion of the combination wrench are machined at 15 degrees from parallel in respect to the centerline of the handle. This permits the use of the wrench in places where there is room to make only a part of a complete turn of a nut or bolt. If the wrench is turned over after the first swing, it will fit on the same flats and turn the nut farther. After two swings on the wrench, the nut is turned far enough so that a new set of flats are in position for the wrench.

The open end of the combination wrench may be used on tubing nuts and in cramped places too small for a socket or box end to be slipped over the nut or bolthead. When using any open-end type wrench, always insure that the wrench fits the nut or bolthead, and pull on the wrench—never push. Pushing a wrench is dangerous. The threads could break loose unexpectedly and cause damage to adjacent equipment or injury to the person using the wrench.

ADJUSTABLE WRENCHES

Adjustable wrenches are not intended to replace open-end wrenches, but they are useful in working in restricted areas. In addition, they can be adjusted to fit odd size nuts. However, adjustable wrenches are not intended for standard use but rather for emergency use. They were not built for use on extremely hard-to-turn items. As shown in figure 7-6, adjustable wrenches have a fixed jaw (A) and an adjustable jaw (B) which is adjusted by a thumbscrew (C). By turning the thumbscrew, the jaw opening may be adjusted to fit various sizes of nuts. The size of the wrenches ranges from 4 to 18 inches in length. The maximum jaw openings vary in direct proportion to the length of the handle.



44.6

Figure 7-6.—Adjustable wrenches.

Adjustable wrenches are often called "knuckle busters" because mechanics frequently suffer the consequences of improper usage of these tools.

There are four simple steps to follow in using these wrenches. First, choose one of the correct size, that is, do not pick a large 12-inch wrench and adjust the jaw for use on a 3/8-inch nut. This could result in a broken bolt and a bloody hand. Second, be sure the jaws of the correct size wrench are adjusted to fit snugly on the nut. Third, position the wrench around the nut until the nut is all the way into the throat of the jaws. If not used in this manner, the result is apt to be as bloody as before. Fourth, pull the handle toward the side having the adjustable jaw. This will prevent the adjustable jaw from springing open and slipping off the nut. If the location of the work will not allow all four steps to be followed when using an adjustable wrench, then select another type of wrench for the job.

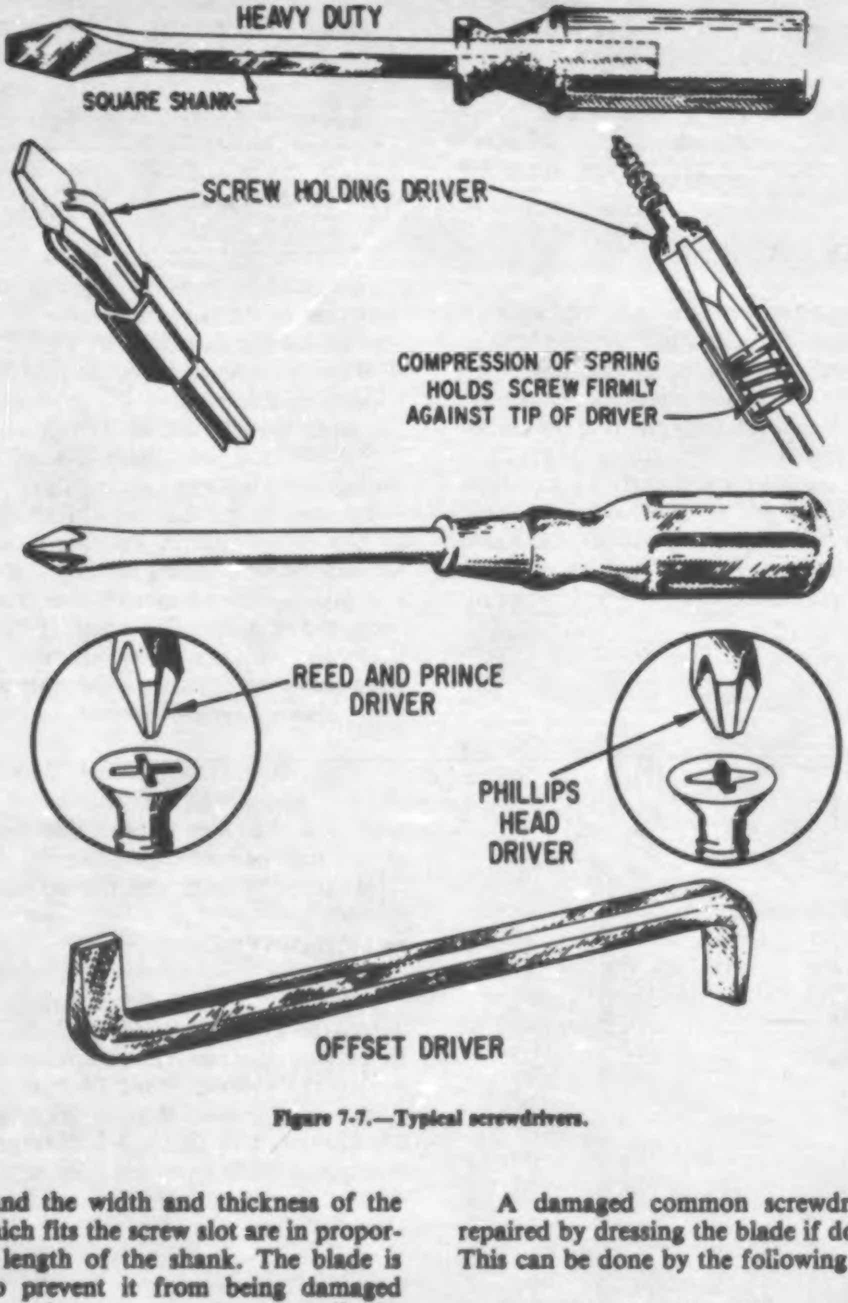
Adjustable wrenches should be cleaned in a solvent, and a light oil applied to the thumbscrew and the sides of the adjustable jaw. They should also be inspected often for cracks which might result in failure of the wrench.

SCREWDRIVERS

Two basic screwdriver blade types are used—the common blade for use on conventional slotted screws and a crosspoint blade for use on the recessed head Phillips or Reed and Prince type screws. Both types of screwdrivers are illustrated in figure 7-7. The common and crosspoint blade types are used in the design of various special screwdrivers, some of which are also shown in figure 7-7.

Common Screwdrivers

The combined length of the shank and blade identifies the size of common screwdrivers. They vary from 2 1/2 to 12 inches. The diameter of


HEAVY DUTY
SQUARE SHANK
SCREW HOLDING DRIVER
COMPRESSION OF SPRING HOLDS SCREW FIRMLY AGAINST TIP OF DRIVER
REED AND PRINCE DRIVER
PHILLIPS HEAD DRIVER
OFFSET DRIVER

1.14

Figure 7-7.—Typical screwdrivers.

the shank and the width and thickness of the blade tip which fits the screw slot are in proportion to the length of the shank. The blade is hardened to prevent it from being damaged when it is used on screws. It can easily be chipped or blunted when used for other purposes. The blade of a poor quality screwdriver will sometimes become damaged even when being used properly.

A damaged common screwdriver may be repaired by dressing the blade if done correctly. This can be done by the following instructions:

1. Dress the sides with an emery wheel so that the blade is symmetrical in shape.
2. Square off the end with the wheel; check for squareness by resting the tip on the handle of a trysquare, and move the shank of the

screwdriver close to the blade of the trysquare. If the blade of the trysquare and shank are parallel, the tip is square.

Crosspoint Screwdrivers

There are two types of crosspoint screwdrivers in common use—the Reed and Prince, and the Phillips. The Reed and Prince screwdrivers and Phillips screwdrivers are not interchangeable; therefore, always use Reed and Prince screwdriver with Reed and Prince screws and a Phillips screwdriver with Phillips screws. The use of the wrong screwdriver will result in mutilation of the screwhead.

Offset Screwdrivers

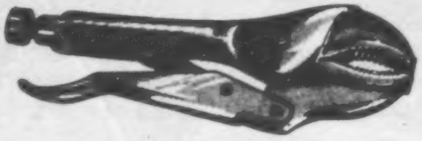
An offset screwdriver (figure 7-7) may be used where there is not sufficient vertical space for a standard screwdriver. Offset screwdrivers are constructed with one blade forged in line and another blade forged at right angles to the shank handle. Both blades are bent 90 degrees to the shank handle. By alternating ends, most screws can be seated or loosened even when the swinging space is very restricted. Offset screwdrivers are made for both standard and recessed head screws.

CAUTION: When using any type of screwdriver, do not hold the work in the hand. If the point slips, it can cause a bad cut. The AS will always be safe when following this rule: Never get any part of the body in front of the screwdriver point. This is a good safety rule for any sharp-pointed tool. When removing a screw from an assembly that is not stationary, hold the work on a solid surface, in a vise, or with some other holding tool.

HOLDING TOOLS

VISE GRIP PLIERS

The AS uses this tool a number of ways. These pliers can be adjusted to various jaw openings by turning the knurled adjusting screw at the end of the handle. Vise grips can be clamped and locked in position by pulling the lever toward the handle. The vise grip pliers are shown in figure 7-8. They may be used as a clamp, speed wrench, portable vise, and for many other uses where a locking, plier-type jaw may be employed.



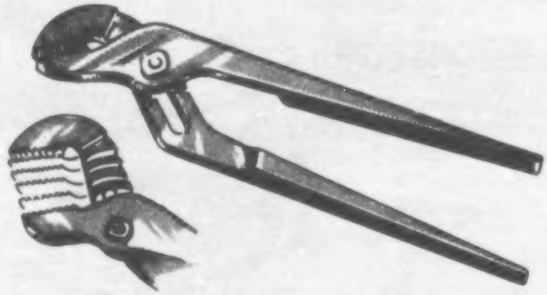
1.21D

Figure 7-8.—Vise grip pliers.

CAUTION: Vise grip pliers should be used with care since the teeth in the jaws tend to damage the object on which they are clamped. They should not be used on nuts, bolts, tube fittings, or other objects which must be reused.

CHANNEL-LOCK PLIERS

Channel-lock pliers (figure 7-9) can be easily identified by the extra-long handles, which make them a very powerful gripping tool. The inner surfaces of the jaws consist of a series of coarse teeth formed by deep grooves, a surface adapted to grasping cylindrical objects. Channel locks have grooves on one jaw and lands on the other. The adjustment is effected by changing the position of the grooves and lands. The channel locks are less likely to slip from the adjustment setting when gripping an object. The channel-lock pliers



1.21B

Figure 7-9.—Channel-lock pliers.

will only be used where it is impossible to use a more adapted wrench or holding device. Many nuts and bolts and surrounding parts have been damaged by improper use of channel-lock pliers.

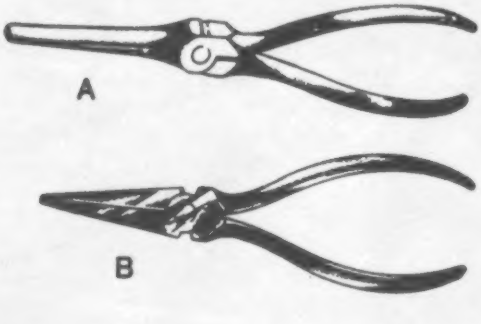
DUCKBILL PLIERS

Duckbill pliers (A, figure 7-10) have long wide jaws and slender handles. Duckbills are used in confined areas where the fingers cannot be used. The jaw faces of the pliers are scored to aid in holding an item securely.

NEEDLE-NOSE PLIERS

Needle-nose pliers (B, figure 7-10) are used in the same manner as duckbill pliers. However, there is a difference in the design of the jaws. Needle-nose jaws are tapered to a point which makes them adapted to installing and removing small cotter pins. They have serrations at the nose end and a side cutter near the throat. Needle-nose pliers may be used to hold small items steady, to cut and bend wire, or to do numerous other jobs which are too intricate or too difficult to be done by hand alone.

NOTE: Duckbill and needle-nose pliers are especially delicate. Care should be exercised when using these pliers to prevent springing, breaking, or chipping the jaws. Once these pliers are damaged, they are practically useless.



1.21C

Figure 7-10.—Pliers. (A) duckbills; and (B) needle-nose.

MISCELLANEOUS TOOLS

MECHANICAL FINGERS

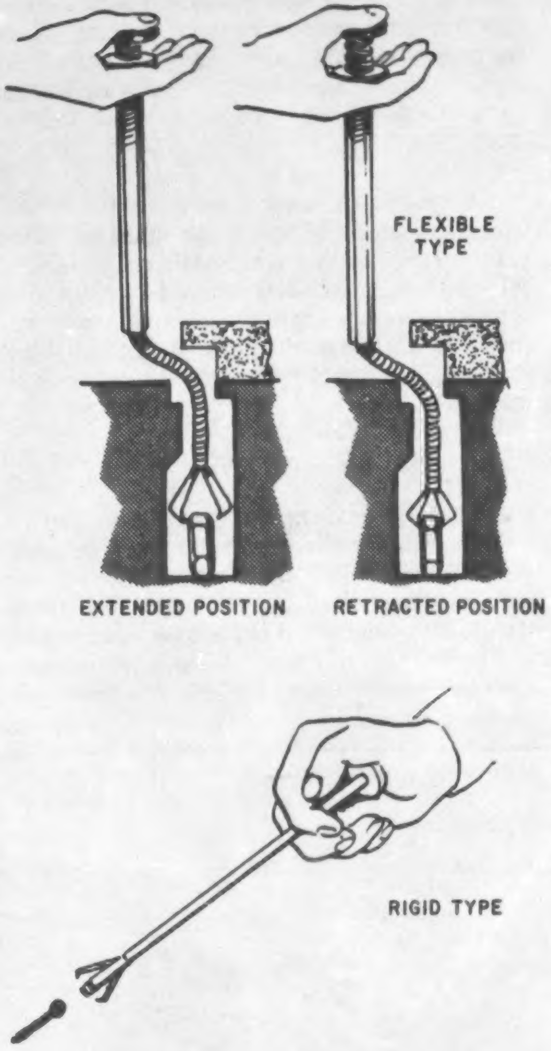
Small articles which have fallen into places where they cannot be reached by hand may be retrieved with the mechanical fingers. This tool is also used when starting nuts or bolts in difficult areas. The mechanical fingers, shown in figure 7-11, have a tube containing flat springs which extend from the end of the tube to form clawlike fingers, much like the screw holder. The springs are attached to a rod that extends from the outer end of the tube. A plate is attached to the end of the tube, and a similar plate to be pressed by the thumb is attached to the end of the rod. A coil spring placed around the rod between the two plates holds them apart and retracts the fingers into the tube. With the bottom plate grasped between the fingers and enough thumb pressure applied to the top plate to compress the spring, the tool fingers extend from the tube in a grasping position. When the thumb pressure is released, the tool fingers retract into the tube as far as the object they hold will allow. Thus, enough pressure is applied on the object to hold it securely. Some mechanical fingers have a flexible end on the tube to permit their use in close quarters or around obstructions.

NOTE: Mechanical fingers should not be used as a substitute for wrenches or pliers. The fingers are made of thin sheet metal and can be easily damaged by overloading.

STEEL SCALE

The steel scale shown in figure 7-12 is a measuring device that will usually be found in the AS toolbox. It is graduated in divisions of 1/8 and 1/16 inch on one side and 1/32 and 1/64 inch on the other side. The steel scale most commonly used is 12 inches long.

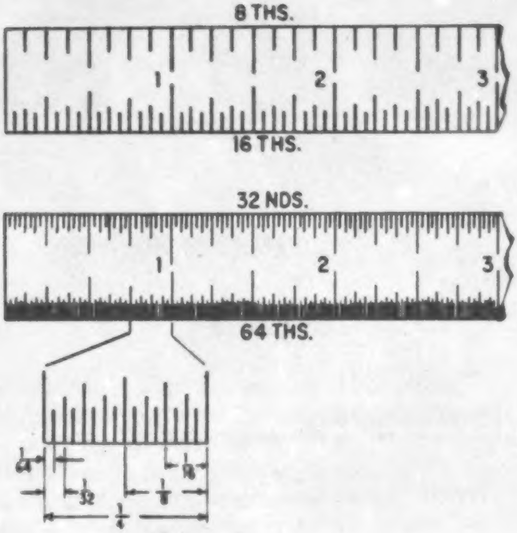
Measurements are taken with a steel scale by holding it on its edge on the surface of the subject being measured. This will prevent making errors which might be caused by the thickness of the scale. Such thickness causes the graduations to be a slight distance away from the surface of



44.211

Figure 7-11.—Mechanical fingers.

the object. Measurements are read at the graduation which coincides with the distance to be measured.



2.3.28

Figure 7-12.—Scale rule.

FLASHLIGHT

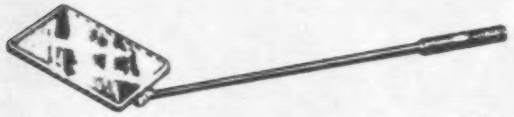
Each toolbox should have a standard Navy vaporproof two-cell flashlight. The flashlight is used constantly during all phases of maintenance. Installed in both ends of the flashlight are rubber seals which keep out all vapors. The flashlight should be inspected periodically for the installation of these seals, the spare bulb, and colored filters which are contained in the end cap.

NOTE: Do not throw away the filters; they will be necessary during night work on or near the aircraft line.

INSPECTION MIRROR

There are several types of inspection mirrors available for use in aviation support equipment maintenance. The mirror is issued in a variety of sizes and may be round or rectangular. The mirror is connected to the end of a rod and may be fixed or adjustable. (See figure 7-13.)

The inspection mirror aids in making detailed inspection where the human eye cannot directly see the inspection area. By angling the mirror, and with the aid of a flashlight, it is possible to inspect most required areas.



44.212

Figure 7-13.—Typical inspection mirror.

NONMAGNETIC TOOLS

Tools made of nonmagnetic materials are available through normal supply channels. They are used for performing specific maintenance tasks on certain classes of equipment or components, such as equipment containing magnets. These tools are normally made of beryllium-copper or plastic, are not as rugged as steel tools, and are much more easily damaged. Restricting their use to the purpose for which they were intended will prolong their useful life and increase their usefulness when required.

In addition to possible damage of the tool itself, indiscriminate use of these tools could allow them to transfer foreign particles to locations where possible trouble could result.

Good general maintenance practice involves wiping the tools before use and again after use. This is especially advisable in the case of nonmagnetic tools. A lint-free cloth dampened with an approved cleaning solvent may be used for this purpose.

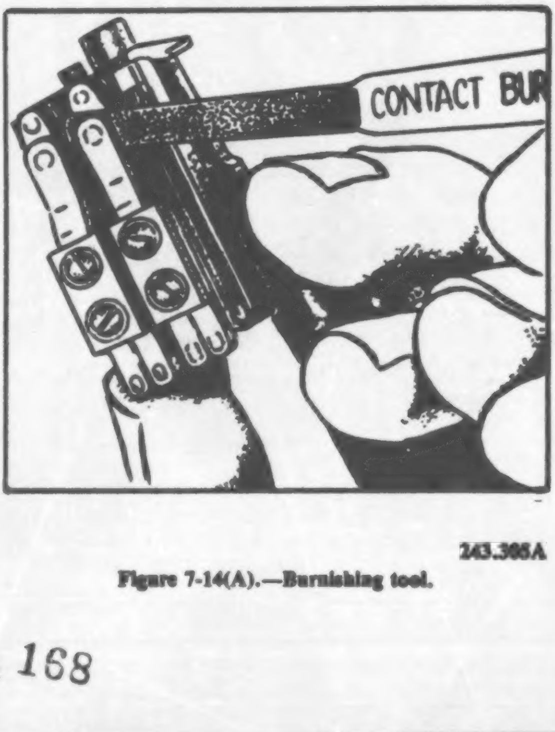
INSULATED TOOLS

Safety considerations require use of insulated tools whenever the danger of electrical shock or short circuit exists. Many types of tools are available in insulated form directly through supply channels at little or no additional cost. These tools should be obtained and used whenever available. However, many types of insulated tools are not readily available (or are available only at considerable added expense). If essential, these tools should be procured or conventional tools may be modified. Insulated sleeving may be put on the handles of pliers and wrenches and on the shanks of screwdrivers. Tools modified in this manner should be used only for low voltage circuits because of the limitations of the insulating materials. For higher voltage uses, special insulating handles are available for many of the common types of tools.

In some instances, it is necessary to use tools which are made of insulating material, rather than merely having an insulating handle. In these instances, the tools should be requisitioned through normal supply channels, if possible. If they are not available through normal supply channels, they may be purchased on the open market.

RELAY TOOLS

Many relays have been damaged or destroyed by the use of sandpaper or emery cloth to clean the contact points. Use of these abrasives causes bending of the contacts, and attempts to straighten them with longnose pliers cause further damage, eventually requiring replacement of the relays. This can be avoided by using a burnishing tool to clean dirty contact points. Figure 7-14(A) illustrates a burnishing tool being used on a relay.



243.305A

Figure 7-14(A).—Burnishing tool.

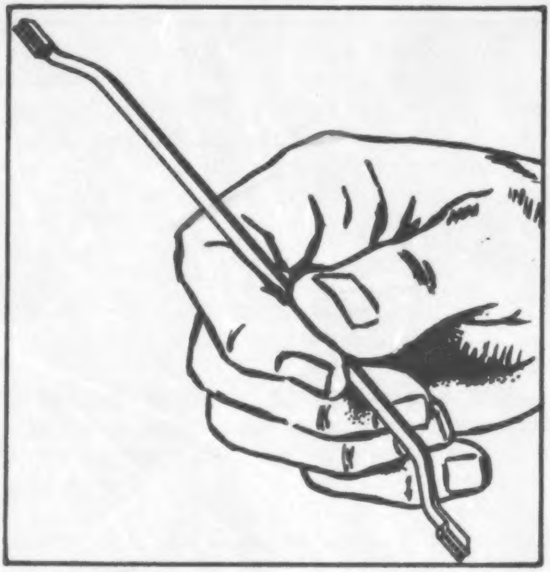
Burnishing tools are stocked in supply activities and may be obtained through normal supply channels. When using this tool, be sure to clean it thoroughly with alcohol; do not touch the tool surface with the fingers prior to use.

Burned and pitted contacts cannot be repaired by burnishing. Such relays should be replaced.

Another tool useful in relay maintenance is a point bender which is used to straighten bent relay contacts. The point bender may be obtained through normal supply channels or manufactured locally from flat stock shaped as shown in figure 7-14(B). The actual size may vary according to the relay being repaired, but the point bender should be small enough to allow freedom of movement so as not to damage other parts of the relay.

WIRE AND CABLE STRIPPERS

Nearly all wire and cable used as electrical conductors are covered with some type of insulation. In order to make electrical connections with the wire, a part of this insulation must be removed, leaving the end of the wire bare. To facilitate the removal of this insulation, use a wire and cable stripping tool similar to the one shown in figure 7-15.



243.305B

Figure 7-14(B).—Point bender.

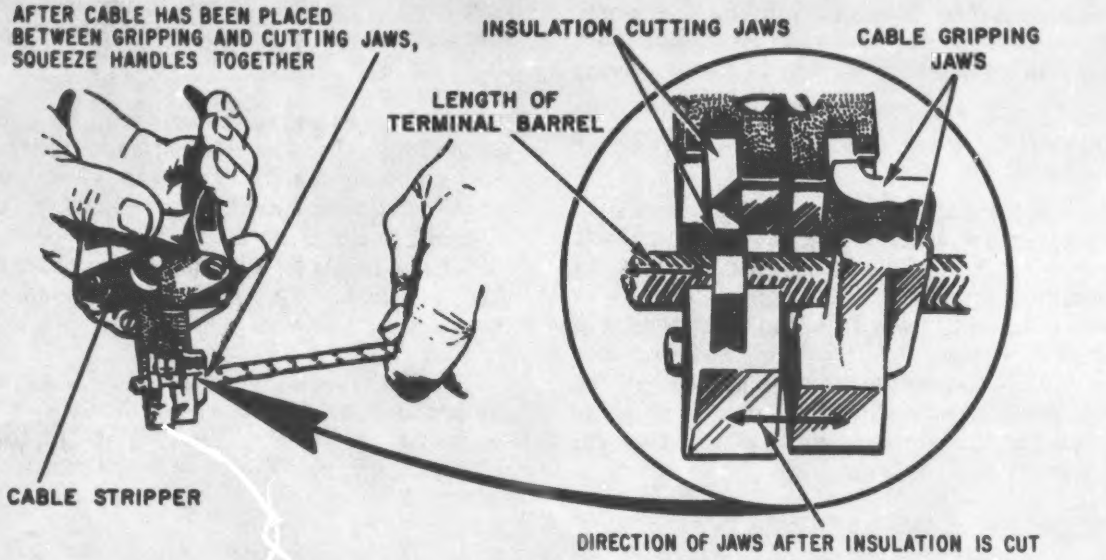
Although several variations of this basic tool are available, the most efficient and effective is the type illustrated. Its operation is extremely simple—insert the end of the wire in the proper direction to the depth to be stripped, position the wire so that it rests in the proper groove for that size wire, and squeeze. The tool functions in three steps as follows:

1. The cable gripping jaws close, clamping the insulated wire firmly in place. The wire must be inserted so that the jaws clamp the main section of the wire rather than the end to be stripped.

2. The insulation cutting jaws close, cutting the insulation. If the wire is not inserted in a groove, the conductor will also be cut. If the wire is positioned into too small a groove, some of the strands will be severed. If the groove is too large, the insulation will not be completely severed. Inserted properly into the correct groove, the insulation will be cut neatly and completely, and the wire will not be damaged.

3. The two sets of jaws separate, removing the clipped insulation from the end of the wire. The jaws are spring loaded to the closed position; therefore, the handles must be squeezed until the jaws reach the full open and locked position. This prevents the cutting jaws from closing (which would damage end of wire) and allows cable gripping jaws to open, releasing the wire.

If cable and wire strippers of this type are not available, notches may be cut in the jaws of diagonal pliers or pocket fingernail clippers, using jeweler's files. Care must be taken to file the grooves into the proper positions in opposing jaws, and the size of the groove must be appropriate for the size wire on which it is to be used. When properly modified, these tools will perform satisfactorily if the more desirable stripper is not available.


AFTER CABLE HAS BEEN PLACED BETWEEN GRIPPING AND CUTTING JAWS, SQUEEZE HANDLES TOGETHER
INSULATION CUTTING JAWS
CABLE GRIPPING JAWS
LENGTH OF TERMINAL BARREL
CABLE STRIPPER
DIRECTION OF JAWS AFTER INSULATION IS CUT

243.278

Figure 7-15.—Wire and cable stripper.

CRIMPING TOOLS

TYPE MS 25037-1.—The standard tool MS 25037-1, issued for crimping solderless terminals, is for use with standard insulated copper terminal lugs manufactured according to MS 25036. The standard tool employs a double jaw to hold the terminal lug or splice. One side of the jaw applies crimping action to fasten the terminal to the bare wire when the terminal is inserted, as shown at the left in figure 7-16. When the tool is used correctly, a deep crimp is placed in the B area of terminal lugs and splices, as shown on the right in figure 7-16. A shallow crimp is applied to the portion of the terminal or splice which extends over the insulation of the wire, as indicated by the A area in the diagrams. This clamping action is provided by a recessed portion in the other side of the divided jaw. A guard, which should be in the position shown when crimping terminals, aids in proper positioning of the terminal. However, the guard must be moved out of the way when the tool is used for crimping splices.

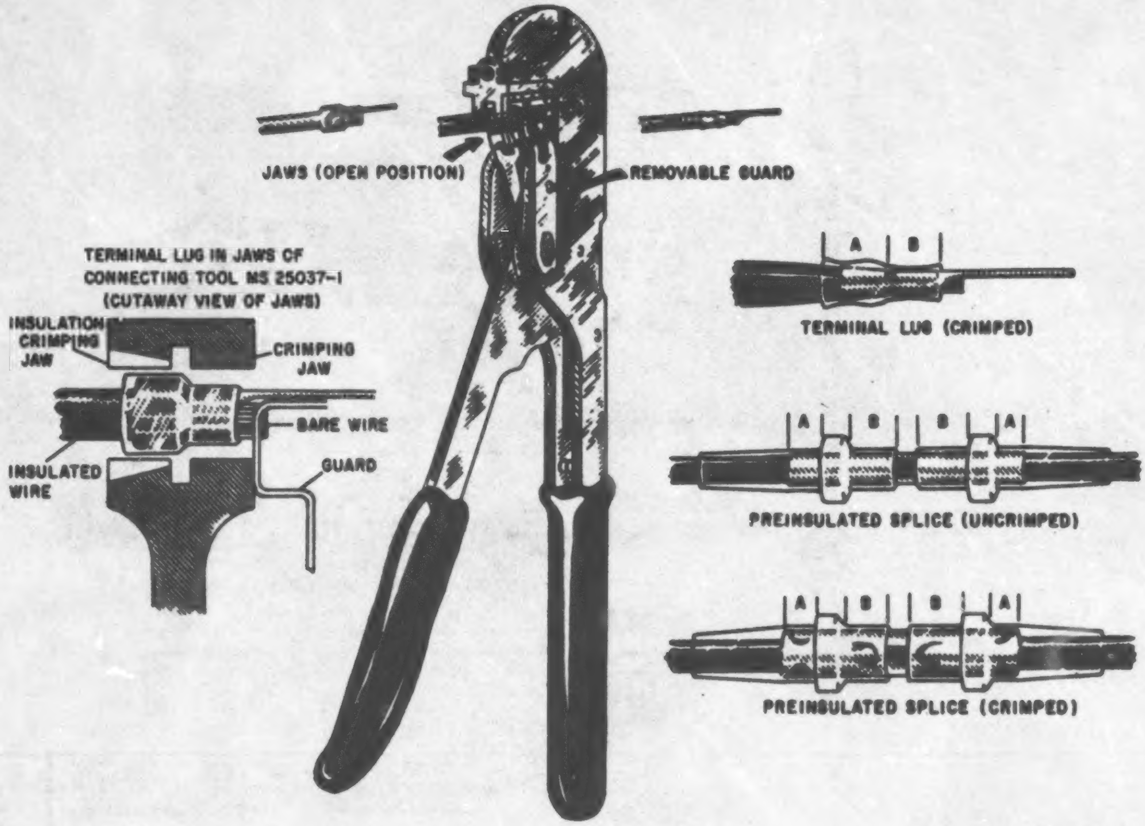
Without the guard, the tool may be used incorrectly when crimping terminals; for example, the terminal might be inserted from the wrong side of the tool. The result is that the deep crimp is placed in the A area of the terminal and, although the wire may be held securely in place, the connection is poor. Common sense indicates that the deep crimp must clamp the metal of the terminal to the bare metal of the wire in order to provide a good electrical and mechanical connection.

The MS 25037-1 tool requires an occasional go-no-go check for wear. A No. 36 (0.106) drill rod should not enter the smaller (red or blue) nest when the tool is fully closed. If it does enter, have the tool repaired.

Instruction in proper crimping procedure should be furnished to all who need to make solderless terminal connections. Handbook of Installation Practices for Aircraft Electric and Electronic Wiring, NAVAIR 01-1A-505, contains detailed procedures for using many solderless connector tools.

TORQUE WRENCHES

There are times when, for engineering reasons, a definite pressure must be applied to a


JAWS (OPEN POSITION)
REMOVABLE GUARD
TERMINAL LUG IN JAWS OF CONNECTING TOOL MS 25037-1 (CUTAWAY VIEW OF JAWS)
INSULATION CRIMPING JAW
CRIMPING JAW
BARE WIRE
INSULATED WIRE
GUARD
A
B
TERMINAL LUG (CRIMPED)
A
B
B
A
PREINSULATED SPLICE (UNCRIMPED)
A
B
B
A
PREINSULATED SPLICE (CRIMPED)

207.38

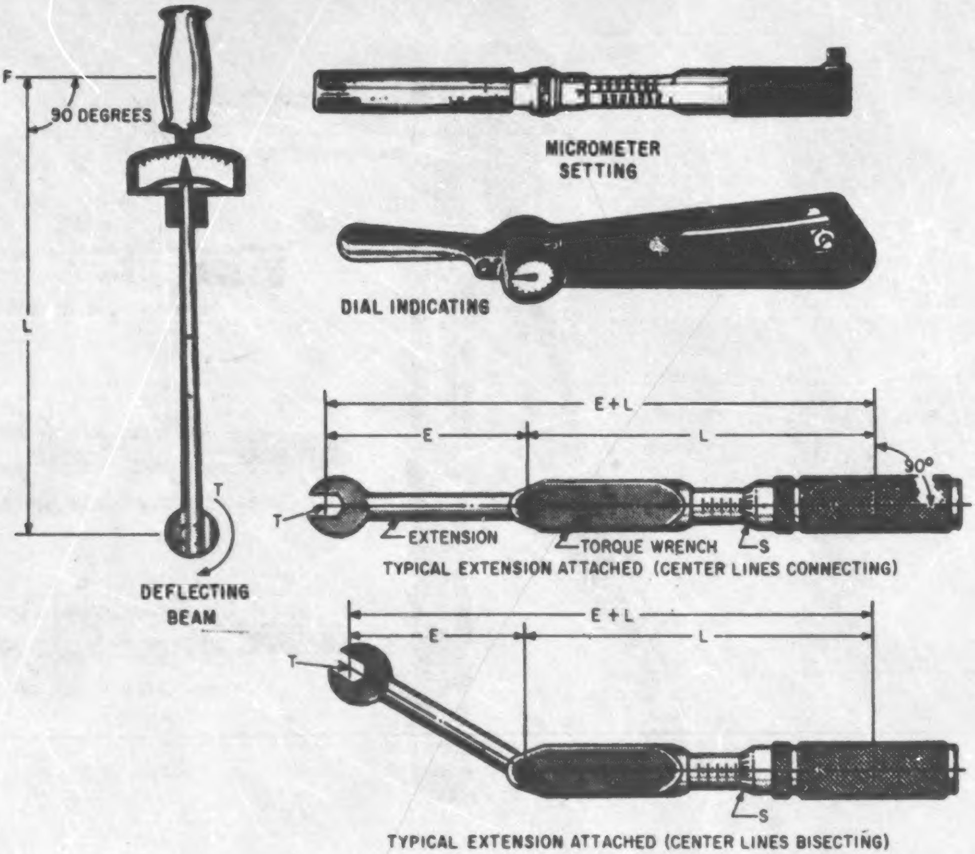
Figure 7-16.—Crimping tool MS25037-1.

nut, bolt, screw, or other fastener. In such cases a torque wrench must be used. The torque wrench is a precision tool consisting of a torque-indicating handle and appropriate adapter or attachments. It is used to measure the amount of turning or twisting force applied to a nut, bolt, or screw.

The three most commonly used torque wrenches are the Deflecting Beam, Dial Indicating, and Micrometer Setting types (figure 7-17). When using the Deflecting Beam and the Dial Indicating torque wrenches, the torque is read visually on a dial or scale mounted on the handle of the wrench.

To use the Micrometer Setting type, unlock the grip and adjust the handle to the desired setting on the micrometer scale, then relock the grip. Install the required socket or adapter to the square drive of the handle. Place the wrench assembly on the nut or bolt and pull in a clockwise direction with a smooth steady motion. (A fast or jerky motion will result in an improperly torqued unit.) When the torque applied reaches the torque value indicated on the handle setting, the handle will automatically release or "break" and move freely for a short distance. The release and free travel is easily felt, so there is no doubt about when the torquing process is complete.

To assure getting the correct amount of torque on the fasteners, all torque handles must be tested at least once a month or more often if usage indicates it is necessary.


F
90 DEGREES
L
T
T
DEFLECTING BEAM
MICROMETER SETTING
DIAL INDICATING
E+L
E
L
90°
T
EXTENSION
TORQUE WRENCH
S
TYPICAL EXTENSION ATTACHED (CENTER LINES CONNECTING)
E+L
E
L
T
S
TYPICAL EXTENSION ATTACHED (CENTER LINES BISECTING)

195.8.1

Figure 7-17.—Torque wrenches.

The following precautions should be observed when using torque wrenches:

1. Do not use the torque wrench as a hammer.

2. When using the Micrometer Setting type, do not move the setting handle below the lowest torque setting. However, it should be placed at its lowest setting prior to returning to storage.

3. Do not use the torque wrench to apply greater amounts of torque than its rated capacity.

4. Do not use the torque wrench to break loose bolts which have been previously tightened.

5. Never store a torque wrench in a toolbox or in an area where it may be damaged.

NOTE: Torque values—Torquing can be described as the twisting stress that is applied to the fasteners to secure components together. These fasteners can be nuts, bolts, studs, clamps, etc. Torque values for these fasteners are expressed in inch-pounds or foot-pounds. Unless otherwise stated, all torque values should be obtained with the manufacturer's recommended thread lubricant applied to the threads.

Torque values are usually listed in the appropriate section of the applicable Instructions Manual. However, in case there is no torque specified, the torque values in table 7-1 can be used as a guide in tightening nuts, bolts, and screws. Using the proper torque allows the structure to develop its design strength and greatly reduces the possibility of failure due to fatigue. One word of caution—never rely on memory for torque information, but look up the correct torque value each time it is needed. A nut or bolt that is not torqued to the proper value may cause damage to the component or equipment.

The proper procedure is to tighten at a uniformly increasing rate until the desired torque is obtained. In some cases, where gaskets or other parts cause a slow permanent set, the torque must be held at the desired value until the material is seated. When applying torque to a series of bolts on a flange or in an area, select a median value. If some bolts in a series are torqued to a minimum value and others to a maximum, force is concentrated on the tighter bolts and is not distributed evenly. Such unequal distribution of force may cause shearing or snapping of the bolts.

Torque wrench size must be considered when torquing. The torque wrenches are listed according to size and should be used within this recommended range. Use of larger wrenches which have too great a tolerance results in inaccuracies. When an offset extension wrench is used with a torque wrench, the effective length of the torque wrench is changed. The torque wrench is so calibrated that when the extension is used, the indicated torque (the torque which appears on the dial or gage of the torque wrench) may be different from the actual torque that is applied

Table 7-1.—Torque value in inch-pounds for standard nuts, bolts, and screws

Wrench size	Standard nuts, bolts, and screws		
	Bolt, stud, or screw size	Tension type nuts AN310 and AN365	Shear type nuts AN320 and AN364
1/4	4-48	4-5.5	2.5-3.5
5/16	6-40	7.5-11	4.5-6.5
11/32	8-36	12-15	7-9
3/8	10-32	20-25	12-15
7/16	1/4-28	50-70	30-40
1/2	5/16-24	100-140	60-85
9/16	3/8-24	160-190	95-110
5/8	7/16-20	450-500	270-300
3/4	1/2-20	480-690	290-410
7/8	9/16-18	800-1,000	480-600
15/16	5/8-18	1,100-1,300	660-780
1 1/16	3/4-16	2,300-2,500	1,300-1,500
1 1/4	7/8-14	2,500-3,000	1,500-1,800
1 7/16	1-14	3,700-5,500	2,200-3,300

NOTE: AN specification numbers may be superseded by MS specification numbers.

to the nut or bolt. Therefore, the wrench must be preset to compensate for the increase when an offset extension wrench is used.

Occasionally, it is necessary to use a special extension or adapter wrench together with a standard torque wrench. In order to arrive at the resultant required torque limits, the following formula should be used

$$S = \frac{T \times L}{(E + L)}$$

Where:

S = Reading of setting on torque wrench.

T = Recommended torque on part.

L = Length of torque wrench (distance between center of drive and center of hand grip).

E = Length of extension of adapter (distance between center of drive and center of broached opening measured in the same place as L).

EXAMPLE: Recommended torque is 100 inch-pounds. Using a 12-inch torque wrench and a 6-inch adapter, determine reading on torque wrench.

$$S = \frac{100 \times 12}{(6 + 12)} \quad \frac{1200}{18} = 66.6 \text{ inch-pounds}$$

An example of the measuring of this formula is shown in figure 7-17. When the extension is pointed back toward the handle of the torque wrench, subtract the effective length of the extension from the effective length of the torque wrench. If the extension is pointed at a right angle to the torque wrench, then the actual value does not change.

It is not advisable to use a handle extension on a deflecting beam type torque wrench at any time. A handle extension alone has no effect on the reading of other types. The use of a drive and extension on any other type of torque wrench makes the use of the formula mandatory. When applying the formula, force must be applied to the handle of the torque wrench at the point from which the measurements were taken. If this is not done, the torque obtained will be in error.

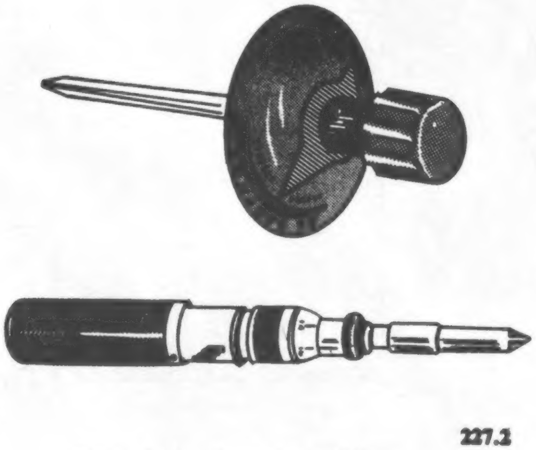
TORQUE SCREWDRIVERS

A variety of torque tools is available, such as the small torque screwdrivers used on watches and instruments. Two types of torque screwdrivers are illustrated in figure 7-18. On one the pointer indicates the applied torque on a circular dial. The other is limited to a preset value in the handle causing it to turn freely when the torque value is reached.

TORQUE CONTROLLED POWER TOOLS

There are two types of torque controlled power tools. The torque controlled nutrunner and screwdriver are used to tighten screws and small nuts to torque values between 10 and 100 inch-pounds. The other torque power tool is a torque controlled impact wrench. It is used for tightening bolts and nuts to torque values between 20 and 100 foot-pounds. Both these tools operate on compressed air at 90 ±10 psi pressure. A flexible hose is used to connect the tool to the air supply.

A torque controlled nutrunner consists of an air motor fitted with a torque limiting device. A



227.2

Figure 7-18.—Torque screwdrivers.

clutch in the torque limiter is released by the action of balls over-riding detents when sufficient resistance is encountered. When the tool is removed from the work, the clutch resets and is ready to tighten the next fastener. The torque at which the clutch releases is set by an adjustment that changes the pressure of the spring that holds the balls in the detents and is dependent on the rundown resistance of the fastener and the materials in the joint.

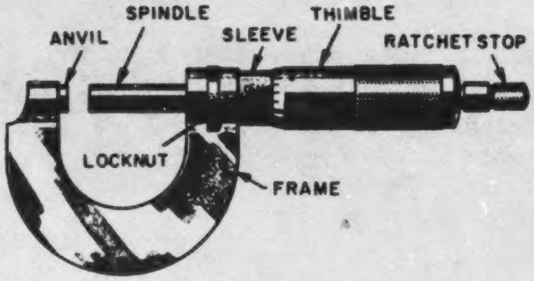
The torque controlled impact wrench consists of an air motor and a hammer mechanism. Torque is controlled by adjustable torsion bars. The three torsion bars provide low range—20 to 45 foot-pounds; medium range—40 to 65 foot-pounds; and high range—60 to 90 foot-pounds. The output torque of the tool is regulated by the amount of torque preset in the torsion bar. When the tool is applied to a fastener, the torsion bar functions as a rigid driving member until the fastener is tightened to a torque value equivalent to the preload torque in the bar. At this point the torsion bar acquires additional twist when the internal hammer in the tool strikes and unwinds between hammer blows. This rebounding action trips a mechanism that shuts off the air and stops the tool.

MICROMETERS

It is important that a person who is working with machinery or in a machine shop thoroughly understands the mechanical principles, construction, use, and care of the micrometer. Figure 7-19 shows an outside micrometer caliper with the various parts clearly indicated. Micrometers are used to measure distances to the nearest one thousandth of an inch. The measurement is usually expressed or written as a decimal; so you must know the method of writing and reading decimals.

TYPES

There are three types of micrometers that are most commonly used throughout the Navy: the outside micrometer caliper (including the screw thread micrometer), the inside micrometer, and the depth micrometer. (See figure 7-20.) The outside micrometer is used for measuring outside dimensions, such as the diameter of a piece of round stock. The screw thread micrometer is used to determine the pitch diameter of screws. The inside micrometer is used for measuring inside dimensions, as for example, the inside diameter of a tube or hole, the bore of a cylinder, or the width of a recess. The depth micrometer is used for measuring the depth of holes or recesses.

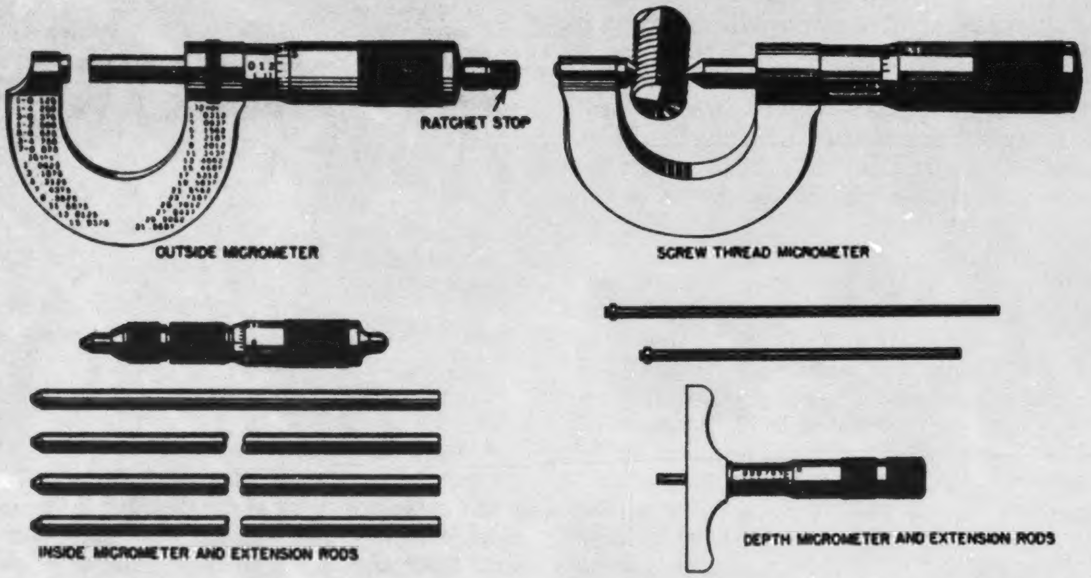


4.20.1A

Figure 7-19.—Nomenclature of an outside micrometer caliper.

SELECTING THE PROPER MICROMETER

The types of micrometers commonly used are made so that the longest movement possible between the spindle and the anvil is 1 inch. This movement is called the "range." The frames of micrometers, however, are available in a wide variety of sizes, from 1 inch up to as large as 24 inches. The range of a 1-inch micrometer is from 0 to 1 inch; in other words, it can be used on work where the part to be measured is 1 inch or less. A 2-inch micrometer has a range from 1 inch to 2 inches, and will measure only work between 1 and 2 inches thick; a 6-inch micrometer has a range from 5 to 6 inches, and will measure only work between 5 and 6 inches thick. It is necessary, therefore, that the mechanic in selecting a micrometer first find the approximate size of the work to the nearest inch, and then select a micrometer that will fit it. For


RATCHET STOP
OUTSIDE MICROMETER
SCREW THREAD MICROMETER
INSIDE MICROMETER AND EXTENSION RODS
DEPTH MICROMETER AND EXTENSION RODS

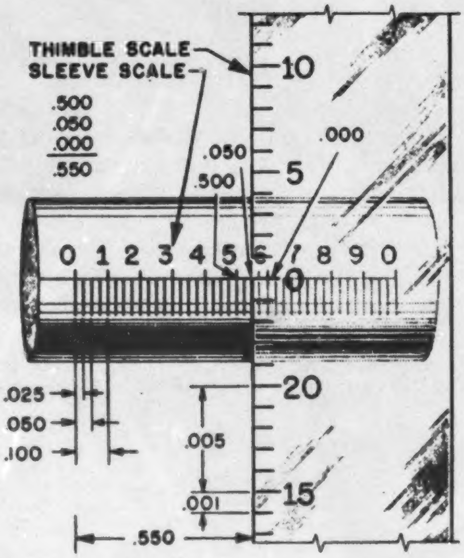
4.20.1B

Figure 7-20.—Common types of micrometers.

example, to find the exact diameter of a piece of round stock; use a rule and find the approximate diameter of the stock. If it is found to be approximately 3 1/4 inches, a micrometer with a 3- to 4-inch range would be required to measure the exact diameter. Similarly, with inside and depth micrometers, rods of suitable lengths must be fitted into the tool to get the approximate dimension within an inch, after which the exact measurement is ready by turning the thimble. The size of a micrometer indicates the size of the largest work it will measure.

READING A MICROMETER CALIPER

The sleeve and thimble scales of the micrometer caliper have been enlarged in figure 7-21. To understand these scales, you need to know that the threaded section on the spindle, which revolves, has 40 threads per inch. Therefore, every time the thimble completes a revolution, the spindle advances or recedes 1/40" (0.025").


THIMBLE SCALE
SLEEVE SCALE
.500
.050
.000
.550
.050
.500
.000
10
5
0 1 2 3 4 5 6 7 8 9 0
0
20
15
.025
.050
.100
.005
.001
.550

29.266D

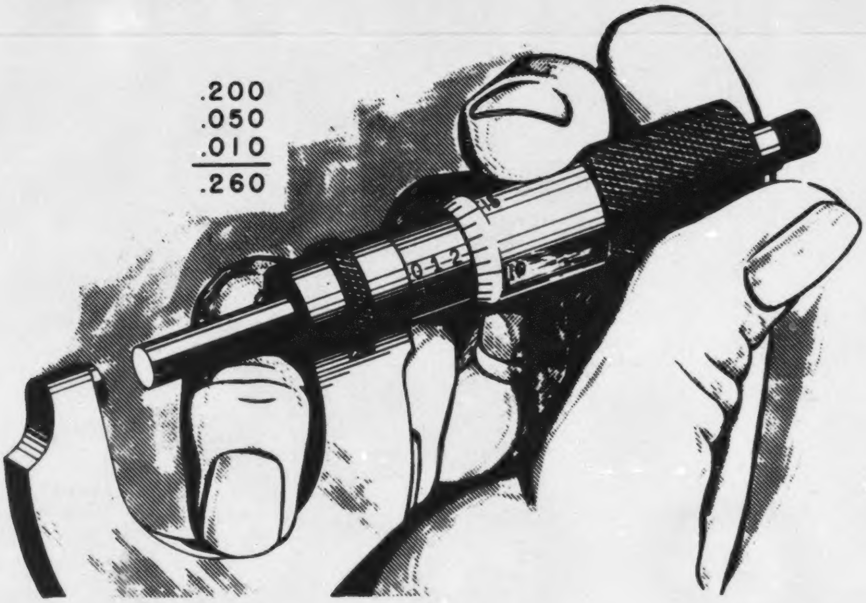
Figure 7-21.—Sleeve and thimble scales of a micrometer (enlarged).

Notice that the horizontal line on the sleeve is divided into 40 equal parts per inch. Every fourth graduation is numbered 1, 2, 3, 4, etc., representing 0.100", 0.200", etc. When you turn the thimble so that its edge is over the first sleeve line past the "0" on the thimble scale, the spindle has opened 0.025". If you turn the spindle to the second mark, it has moved 0.025" plus 0.025" or 0.050 . You use the scale on the thimble to complete your reading when the edge of the thimble stops between graduated lines. This scale is divided into 25 equal parts, each part representing 1/25 of a turn. And 1/25 of 0.025" is 0.001". As you can see, every fifth line on the thimble scale is marked 5, 10, 15, etc. The thimble scale, therefore, permits you to take very accurate readings to the thousandths of an inch, and, since you can estimate between the divisions on the thimble scale, fairly accurate readings to the ten thousandth of an inch are possible.

The closeup in figure 7-22 will help you understand how to take a complete micrometer reading. Count the units on the thimble scale and add them to the reading on the sleeve scale. The reading in the figure shows a sleeve reading of 0.250" (the thimble having stopped slightly more than halfway between 2 and 3 on the sleeve) with the 10th line on the thimble scale coinciding with the horizontal sleeve line. Number 10 on this scale means that the spindle has moved away from the anvil an additional 10 x 0.001" or 0.010". Add this amount to the 0.250" sleeve reading, and the total distance is 0.260".

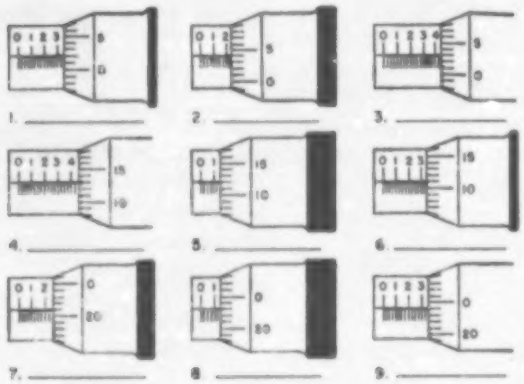
Read each of the micrometer settings in figure 7-23 so that you can be sure of yourself when you begin to use this tool on the job. The correct readings are given following the figure so that you can check yourself.

Figure 7-24 shows a reading in which the horizontal line falls between two graduations on the thimble scale and is closer to the 15 graduation than it is to the 14. To read this to THREE decimal places, refer to figure 7-24 and



4.20.2

Figure 7-22.—Read a micrometer caliper.

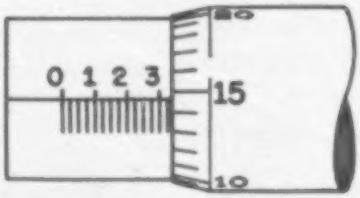


Answers for checking—

1. = 0.327
2. = 0.229
3. = 0.428
4. = 0.438
5. = 0.137
6. = 0.336
7. = 0.246
8. = 0.148
9. = 0.349

4.20

Figure 7-23.—Micrometer-reading exercises.



A { .300, .025, .015, .340

B { .300, .025, .014, .0007, .3397

29.266F

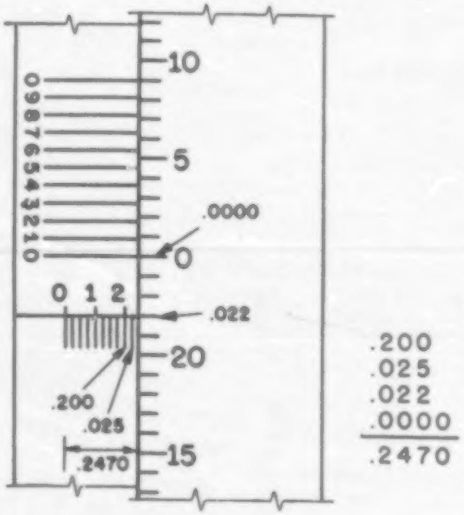
Figure 7-24.—Interpolating a micrometer reading.

calculation A. To read it to FOUR decimal places, estimate the number of tenths of the distance between thimble-scale graduations the horizontal line has fallen. Each tenth of this distance equals one ten-thousandth (0.0001) of an inch. Add the ten-thousandths to the reading as shown in calculation B of figure 7-24.

READING A VERNIER MICROMETER CALIPER

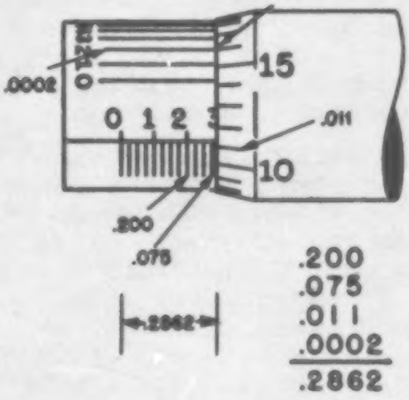
Many times you will be required to work to exceptionally precise dimensions. Under these conditions it is better to use a micrometer that is accurate to ten-thousandths of an inch. This degree of accuracy is obtained by the addition of a vernier scale. This scale, shown in figure 7-25, furnishes the fine readings between the lines on the thimble rather than making you estimate. The 10 spaces on the vernier are equivalent to 9 spaces on the thimble. Therefore, each unit on the vernier scale is equal to 0.0009" and the difference between the sizes of the units on each scale is 0.0001".

When a line on the thimble scale does not coincide with the horizontal sleeve line, you can determine the additional space beyond the readable thimble mark by finding which vernier mark coincides with a line on the thimble scale. Add this number, as that many ten-thousandths of an inch, to the original reading. In figure 7-26



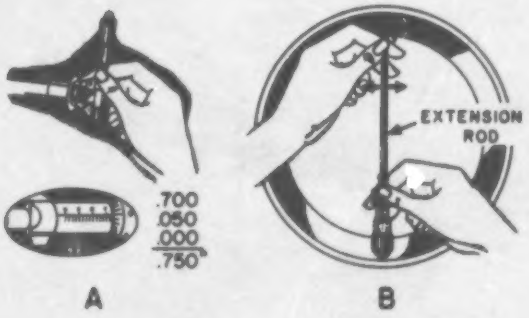
29.266G

Figure 7-25.—Vernier scale on a micrometer.



29.266H

Figure 7-26.—Read a vernier micrometer caliper.



44.77

Figure 7-27.—Measuring an inside diameter with an inside caliper.

see how the second line on the vernier scale coincides with a line on the thimble scale.

This means that the 0.011 mark on the thimble scale has been advanced an additional 0.0002″ beyond the horizontal sleeve line. When you add this to the other readings, the reading will be 0.200 + 0.075 + 0.011 + 0.0002 or 0.2862″, as shown.

MEASURING HOLE DIAMETERS WITH AN INSIDE MICROMETER CALIPER

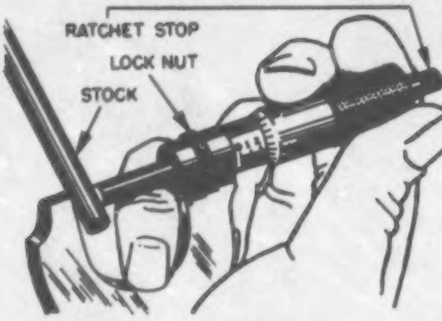
To measure the diameter of small holes from 0.2″ to 1″ in diameter, an inside micrometer caliper of the jaw type as shown in A of figure 7-27 may be used. Note that the figures on both the thimble and the barrel are reversed, increasing in the opposite direction from those on an outside micrometer caliper. This is because this micrometer reads inside measurements. Thus as you turn the thimble clockwise on this micrometer, the measuring surfaces move farther apart and the reading increases. (On an outside micrometer caliper, as you turn the thimble clockwise, the measuring surfaces move closer together and the reading decreases.)

For holes from 2″ up to several feet in diameter, select the inside micrometer having extension rods whose range includes the required dimension. The extension rod marked "6-7," for example, when inserted into the head of the micrometer, will measure inside diameters from 6″ to 7″. The shoulder on the rod must seat properly to ensure a correct reading. B of figure 7-27 shows that, for large measurements, both hands are used to set the micrometer for checking a diameter. Hold one end in place with one hand as you "feel" for the maximum possible setting by moving the other end from left to right, and in and out of the hole with the other hand. When no left-to-right movement is possible, and a slight drag is noticed on the in-and-out swing, take the reading.

MEASURING ROUND STOCK

When measuring the diameter of a small piece of round stock, hold the stock to be measured in one hand. Hold the micrometer in the other hand so that the thimble rests between the thumb and the forefinger. (See figure 7-28.) The third finger is then in a position to hold the frame against the palm of the hand. The frame is supported in this manner and makes it easy to guide the work over the anvil. The thumb and forefinger are in position to turn the thimble either directly or through the ratchet and bring the spindle over against the surface being measured.

Turn the spindle down to contact by "feel," or else use the ratchet stop. Your feel should



4.20.2A
Figure 7-28.—Measuring round stock with a micrometer caliper.

produce the same contact pressure and therefore the same reading as that produced when the ratchet stop is used. Develop your "feel" by measuring a certain dimension both with and without the aid of the ratchet stop. When you have the correct feel, you will get the same readings by both methods.

In measuring round stock the feel must be very light because there is only a line contact between the spindle and the stock and the anvil and the stock. Therefore the contact area is exceptionally small, causing a proportionally high contact pressure per unit of area. This tends to give a reading smaller than the true reading unless the light feel is used. Moreover, in measuring a ball from a ball bearing, the contact is at only two points, so the contact area is again very small, which results in a tremendous pressure per unit of area. This condition requires only the lightest possible contact pressure to give a true reading.

Hold the micrometer lightly and for only as long as is necessary to make the measurement. Wrapping the hand around it or holding it for too long a time will cause expansion of the metal and will introduce errors in measurement. Read the setting on the thimble scale (if the object is small) without removing the micrometer caliper from the object.

MEASURING A FLAT SURFACE

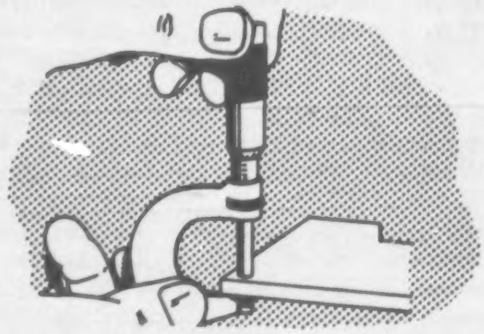
When measuring a flat surface with a micrometer caliper, the entire area of both the anvil and the spindle is in contact with the surface being measured. This causes a proportionally low contact pressure per unit of area. Therefore the "feel" should be slightly heavier than when measuring round stock.

On large flat work, it is necessary to have the work stationary and positioned to permit access for the micrometer. The proper method of holding a micrometer when checking a part too large to be held in one hand is shown in figure 7-29. The frame is held by one hand to position it and to locate it square to the measured surface. The other hand operates the thimble either directly or through the ratchet. A large flat surface should be measured in several places to determine the amount of variation. It is good practice to lock the spindle in place with the locknut before removing the micrometer from the part being measured. After removal of the micrometer the measurement indicated on the thimble scale can then be read.

To retain a particular setting, in cases where several pieces are to be gaged, lock the spindle in place with the locknut. When a piece is "gaged" with a micrometer whose spindle is locked to a particular setting, the piece can quickly be identified as oversize, correct size, or undersize.

CARE OF MICROMETERS

Keep micrometers clean and lightly oiled. Make sure they are placed in a case or box when



4.20.1C
Figure 7-29.—Measuring flat stock with a micrometer caliper.

they are not in use. Anvil faces must be protected from damage and must not be cleaned with emery cloth or other abrasives.

STRIKING TOOLS

HAMMERS

Generally speaking, this group is composed of various types of hammers, all of which are used to apply a striking force where the force of the hand alone is insufficient. Each of these hammers is composed of a head and a handle, even though these parts differ greatly from hammer to hammer. So that the AS may have a better idea of their differences and uses, let's consider the types of hammers used most frequently. (See figure 7-30.)

Ball-Peen Hammer

The ball-peen hammer is sometimes referred to as a machinist's hammer. It is a hard-faced hammer made of forged tool steel.

The flat end of the head is called the face. This end is used for most hammering jobs. The other end of the hammer is called the peen. The peen end is smaller in diameter than the face and is therefore useful for striking areas that are too small for the face to enter.

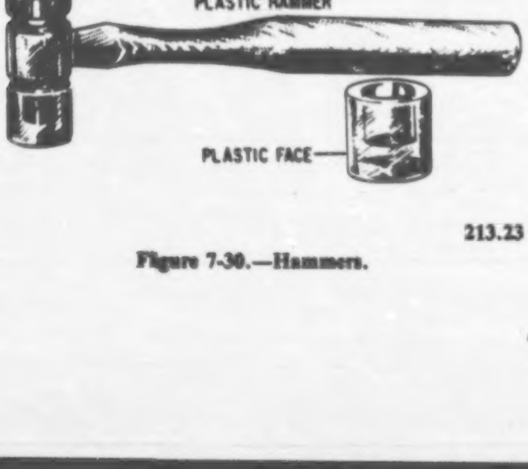


Figure 7-30.—Hammers.

Ball-peen hammers are made in different weights, usually 4, 6, 8, and 12 ounces and 1, 1 1/2, and 2 pounds. For most work, a 1 1/2-pound and a 12-ounce hammer will suffice.

Mallet

A mallet is a soft-faced hammer. Mallets are constructed with heads made of brass, lead, tightly rolled strips of rawhide, and plastic or plastic with a lead core for added weight.

Plastic mallets similar to the one shown in figure 7-30 are the type normally found in the AS's toolbox. The weight of the plastic head may range from a few ounces to a few pounds. The plastic mallet may be used for straightening thin sheet ducting or when installing clamps.

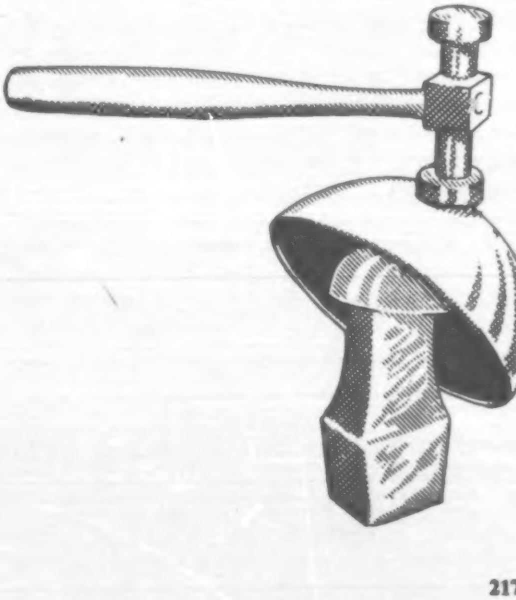
Hammers are dangerous tools when used carelessly and without consideration. Practice will help the AS to learn to use a hammer properly. Some important things to remember when using a hammer or mallet are as follows:

Hold the handle near the end with the fingers underneath and the thumb along the side or on top of the handle. The thumb should rest on the handle and never overlap the fingers. Oils on the face of the hammer will cause it to glance off the work; therefore, wipe the oil off with a rag then rub the face with coarse sandpaper or emery cloth. Never use a hammer which has a loose head or cracked handle. It is dangerous to personnel and to property. Most hammer accidents are caused by a loose head or a slippery handle. So remember this when using any kind of striking tool. Tighten the loose hammerhead by driving a wedge in the end of the handle. This spreads the handle tightly inside the head. Do not strike a hardened steel surface with a steel hammer. Small pieces of steel may break and injure someone or damage the work. Use a soft hammer in striking hardened steel or highly polished stock. If a soft hammer is not available, use a piece of copper, brass, lead, or wood to protect the hardened steel. However, it is permissible to strike a punch or chisel directly with the ball-peen hammer because the steel in the heads of punches and chisels is slightly softer than that of the hammer head.

Planishing Hammer

The planishing hammer has two metal heads with slightly convex faces. The heads may be round, square, or a combination of both. Planishing hammers are lighter than most hammers and are primarily used by the AS to smooth out metal surfaces that have been bent out of shape.

In planishing, place the metal on a smooth surface, such as a forming block or stake, and lightly strike the irregularities with the face of the hammer until smooth. Care must be taken to prevent stretching of the metal by striking with glancing blows. If an oil can (excess metal which will pop up or down if pressed with the fingers) seems to be forming during planishing procedures, it may be necessary to shrink the metal. Shrinking the metal is accomplished by the use of glancing blows in the opposite direction of the blows that caused the stretching. Figure 7-31 shows a planishing hammer being used. Notice the metal is being backed up by a stake.

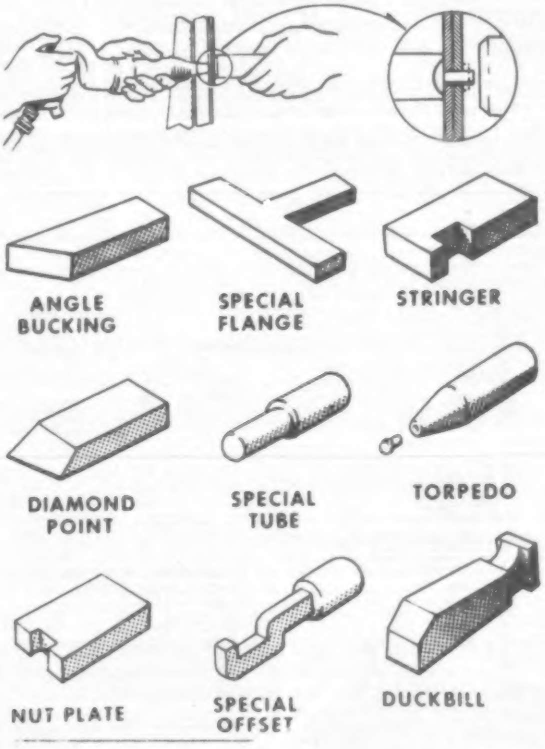


217.56

Figure 7-31.—Using a planishing hammer.

BUCKING BARS

Bucking bars are tools used to form bucktails (the head formed during riveting operations) on rivets. They come in many different shapes and sizes, as illustrated in figure 7-32. Bucking bars are normally made from an alloy steel similar to tool steel. The particular shape to be used depends upon the location and accessibility of the rivet to be driven. The size and weight of the bar also depend on the size of the rivet to be driven. Under certain circumstances, and for specific rivet installations, specially designed bucking bars are manufactured locally. These bars are normally made of tool steel. The portion of the bar designed to come in contact with the rivet has a polished finish. This helps to prevent marring of formed bucktails. Bucking bar faces must be kept smooth and perfectly flat and the edges and corners rounded at all times.



217.20

Figure 7-32.—Bucking bars.

NOTE: Never hold a bucking bar in a vise unless the vise jaws are equipped with protective covers. This will prevent marring of the bucking bar.

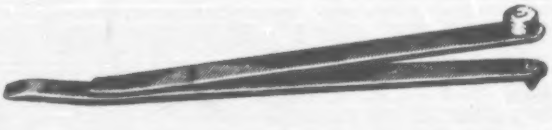
A satisfactory rivet installation depends largely on the condition of the bucking bar and the ability of the AS using it. If possible, hold the bucking bar in such a manner that will allow the longest portion of the bar to be in line with the rivet. The AS should hold the bucking bar lightly but firmly against the end of the rivet shank so as not to unseat the rivet head. The inertia of this tool provides the force that bucks (upsets) the rivet, forming a flat, head-like bucktail.

HOLE FINDER

A hole finder is a tool used to transfer existing holes in structural members or sheet metal to replacement sheet metal or patches. The tool has two leaves parallel to each other and fastened together at one end. The bottom leaf of the hole finder has a teat installed near the end of the leaf which is aligned with a bushing on the top leaf, as illustrated in figure 7-33. The desired hole to be transferred is located by fitting the teat on the bottom leaf of the hole finder into the existing rivet hole. The hole in the new part is made by drilling through the bushing on the top leaf. If the hole finder is properly made, holes drilled in this manner will be perfectly aligned. A separate duplicator must be provided for each diameter of rivet to be used.

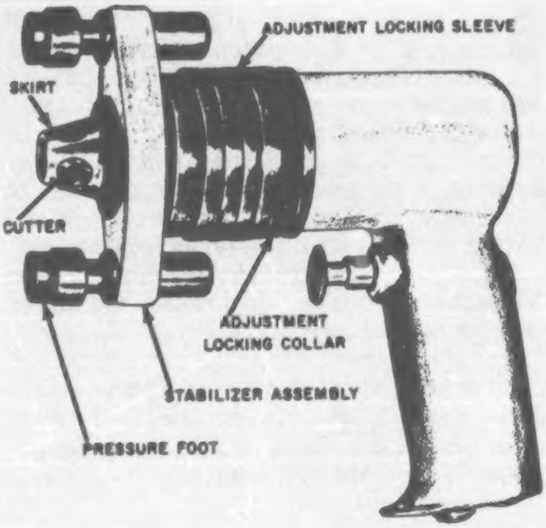
RIVET HEAD SHAVER

The rivet head shaver shown in figure 7-34 is used by the AS to smooth countersunk rivet heads that protrude slightly but are still within specified limits. The rivet head shaver is also called a Micro Miller. This unit operates on compressed air. The depth of cut adjustment can be made in increments of 0.0005 inch on the model shown in figure 7-34. On some models the depth of cut adjustment can be made in increments of 0.0008 inch. The operator can change cutters and adjust their depth without the use of special tools. Once the depth is set, the positive action of the serrated adjustment locking collar prevents accidental loss of setting.



217.21

Figure 7-33.—Hole finder.



217.23

Figure 7-34.—Rivet head shaver.

The AS should position the cutters directly over the rivet head, holding the tool at an angle of 90 degrees to the surface being smoothed. With the tool turning maximum rpm, it is then pressed in towards the surface, maintaining the 90-degree angle. The pressure feet will then be compressed until they bottom out. At this time, assuming the rivet head shaver is adjusted correctly prior to the shaving operating, the rivet head will be shaved smooth.

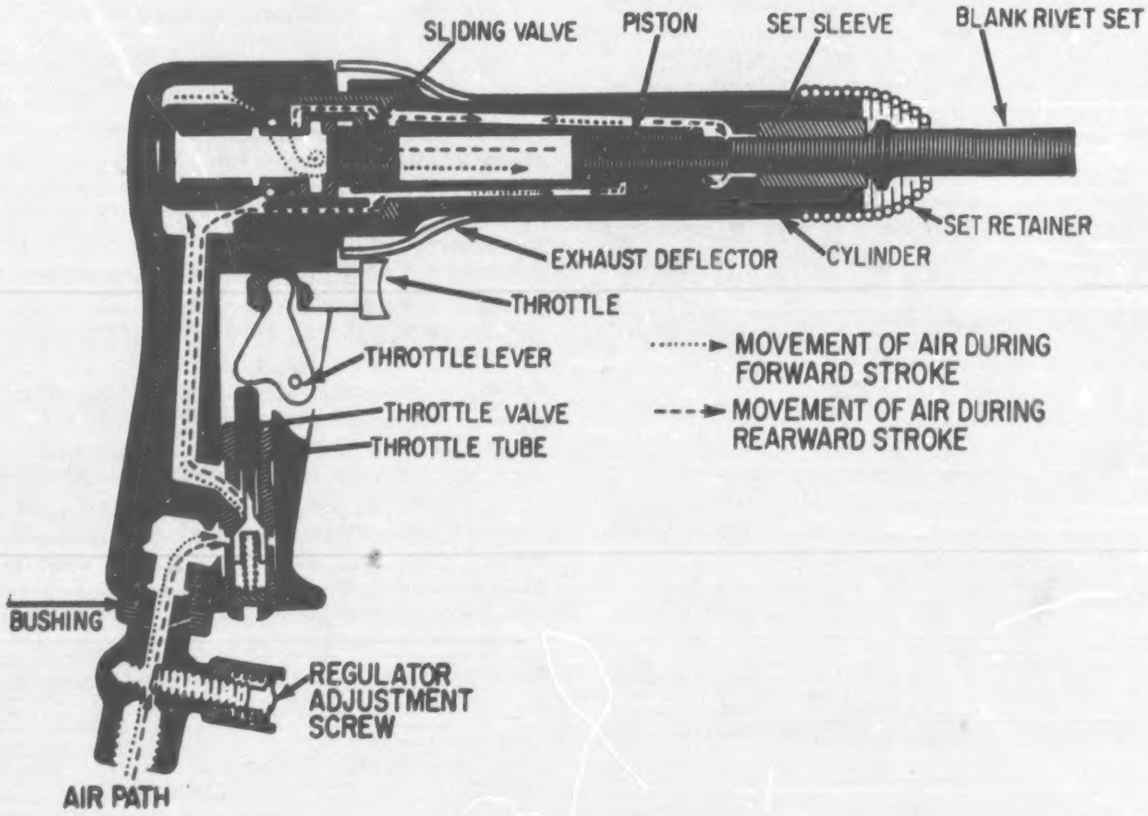
PNEUMATIC RIVETERS

Rivet guns vary in size and shape and have a variety of handles and grips, ranging from the offset type to the pistol grip type. Nearly all riveting is done with pneumatic riveters. The pneumatic riveting guns operate on compressed air supplied from a compressor or storage tank. Normally, rivet guns are equipped with an air regulator on the handle to control the amount of air entering the gun. Regulated air entering the gun (figure 7-35) passes through the handle and throttle valve, which is controlled by the trigger, and into the cylinder in which the piston moves. Air pressure forces the piston down against the rivet set and exhausts itself through side ports. The rivet set recoils, forcing the piston back, and the cycle is repeated. Each time the piston strikes the rivet set, the force is transmitted to the rivet. Rivet sets come in various sizes and shapes to fit the various shaped rivet heads.

Several types of pneumatic riveters are in general use. Included are the one-shot gun, slow-hitting gun, fast-hitting gun, corner riveter, and squeeze riveter. (See figure 7-35.) The type of gun used depends on the particular job at hand, each type having its advantage for certain types of work. Small parts can be riveted by one man if the part is accessible for both bucking and driving, provided the work is properly secured. The greatest part of riveted work, however, requires two men.

One-Shot Gun

The one-shot gun is designed to drive the rivet with just one blow. It is larger and heavier than other types and is generally used for heavy


SLIDING VALVE
PISTON
SET SLEEVE
BLANK RIVET SET
SET RETAINER
EXHAUST DEFLECTOR
CYLINDER
THROTTLE
THROTTLE LEVER
THROTTLE VALVE
THROTTLE TUBE
MOVEMENT OF AIR DURING FORWARD STROKE
MOVEMENT OF AIR DURING REARWARD STROKE
BUSHING
REGULATOR ADJUSTMENT SCREW
AIR PATH

217.24

Figure 7-35.—Rivet gun internal airflow.

riveting. Each time the trigger is depressed the gun strikes one blow. It is rather difficult to control on light-gage metals. Under suitable conditions it is the fastest method of riveting.

Slow-Hitting Gun

The slow-hitting gun has a speed of 2,500 bpm (blows per minute). As long as the trigger is held down, the rivet set continues to strike the rivet. This gun is widely used for driving medium-size rivets. It is easier to control than the one-shot gun.

Fast-Hitting Gun

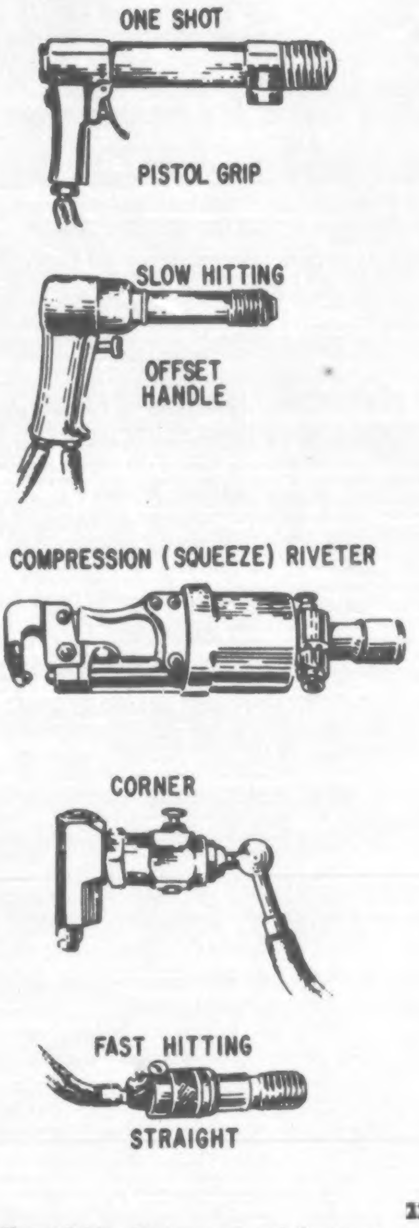
The fast-hitting gun heads the rivet with a number or relatively lightweight blows. It strikes between 2,500 and 5,000 bpm and is generally used with softer rivets. Like the slow-hitting gun, it continues to strike the rivet head as long as the trigger is depressed. This gun is sometimes referred to as a vibrator.

Corner Riveter

The corner riveter is so named because it can be used in corners and in close quarters where space is restricted. The main difference between this riveter and the other types described lies in the fact that in this type the set is very short and can be used in confined spaces as can be seen in figure 7-36.

Squeeze Riveter

The squeeze riveter differs from the other riveters in that it forms the rivet head by means of squeezing or compressing instead of by distinct blows. Once it is adjusted for a particular type of work, it will form rivet heads of greater uniformity than the riveting guns. It is made both as a portable unit and as a stationary riveting machine. As a portable unit, it is larger than the riveting guns and can be used only for certain types of work that can be accommodated between the jaws. The stationary, or fixed jaw, contains the set and is placed against the rivet head in driving. The rivet squeezer illustrated in figure 7-36 is the portable pneumatic unit.



117.25

Figure 7-36.—Various types of rivet guns.

Rivet Gun Selection

The size and the type of gun used for a particular job depend upon the size of rivets being driven and the accessibility of the rivet. For

Table 7-2.—Approximate air pressure for rivet guns

Rivet size	Air pressure psi
3/32	35
1/8	40
5/32	60
3/16	90

driving medium-size, heat-treated rivets which are in accessible places, the slow-hitting gun is preferred. For small, soft alloy rivets, the fast-hitting gun is preferable. There will be places where a conventional type gun cannot be used. For this type work, a corner gun is employed.

The larger the rivet, the greater the air pressure that is required. Air pressure reaches the gun through a long, flexible hose. Approximate air pressures for four of the most common rivet sizes are given in table 7-2. Conditions may vary slightly with different metals.

PULLERS

Pullers are designed to facilitate pulling operations such as removing bearings, gears, wheels, pulleys, sheaves, bushings, cylinder sleeves, shafts, and other closefitting parts.

Types of Pullers

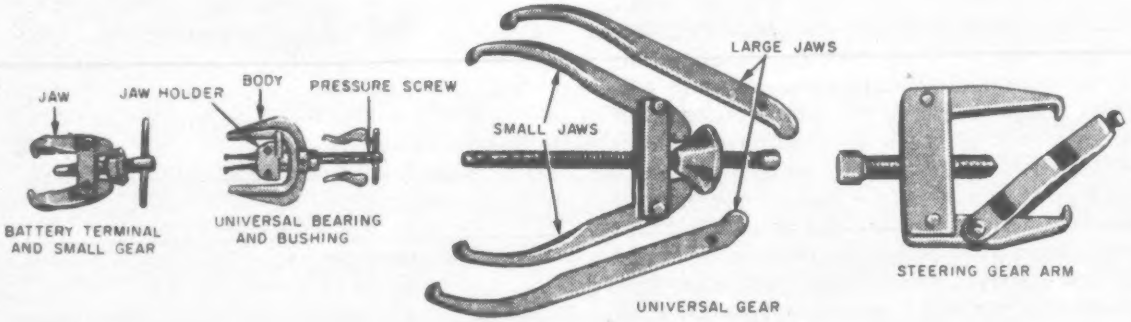
UNIVERSAL GEAR PULLERS (figure 7-37).—These are usually of yoke and screw construction with two jaws. The jaws have from 0 to 14 inches diameter capacity, and have a reach from 3 to 16 inches.

UNIVERSAL BEARING AND BUSHING PULLER (figure 7-37).—This has a pulling capacity of 1 1/4 inches. The larger jaws are designed to remove bronze or oilite bushings without crumbling them. The small jaws will clutch pilot bearings. The puller consists of a U-shaped body, a jaw holder, two large jaws, two small jaws, two jaw pins, and a pressure screw with slide bar.

BATTERY TERMINAL AND SMALL GEAR PULLER (figure 7-37).—This is of the screw-type and is capable of use in close quarters. Besides pulling battery terminals, it is used to pull small gears, bearings, etc.

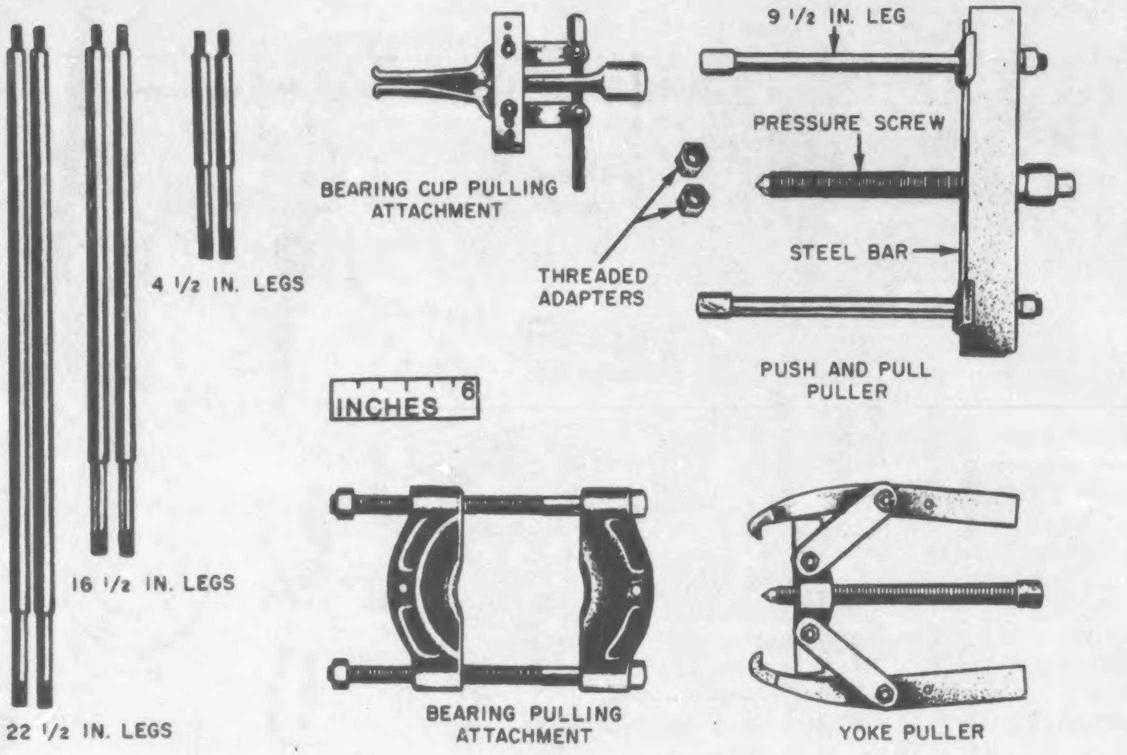
STEERING GEAR ARM PULLER (figure 7-37).—This can also be used for a wide variety of jobs. The clamp locks the puller on the arm, leaving both hands free for the actual pulling operation.

PUSH AND PULL PULLER SET (figure 7-38).—It is used in conjunction with a number of attachments and adapters. The push and pull



81.27

Figure 7-37.—Bearing, bushing, and gear pullers.


9 1/2 IN. LEG
PRESSURE SCREW
BEARING CUP PULLING ATTACHMENT
THREADED ADAPTERS
STEEL BAR
4 1/2 IN. LEGS
PUSH AND PULL PULLER
INCHES
6
16 1/2 IN. LEGS
22 1/2 IN. LEGS
BEARING PULLING ATTACHMENT
YOKE PULLER

81.28

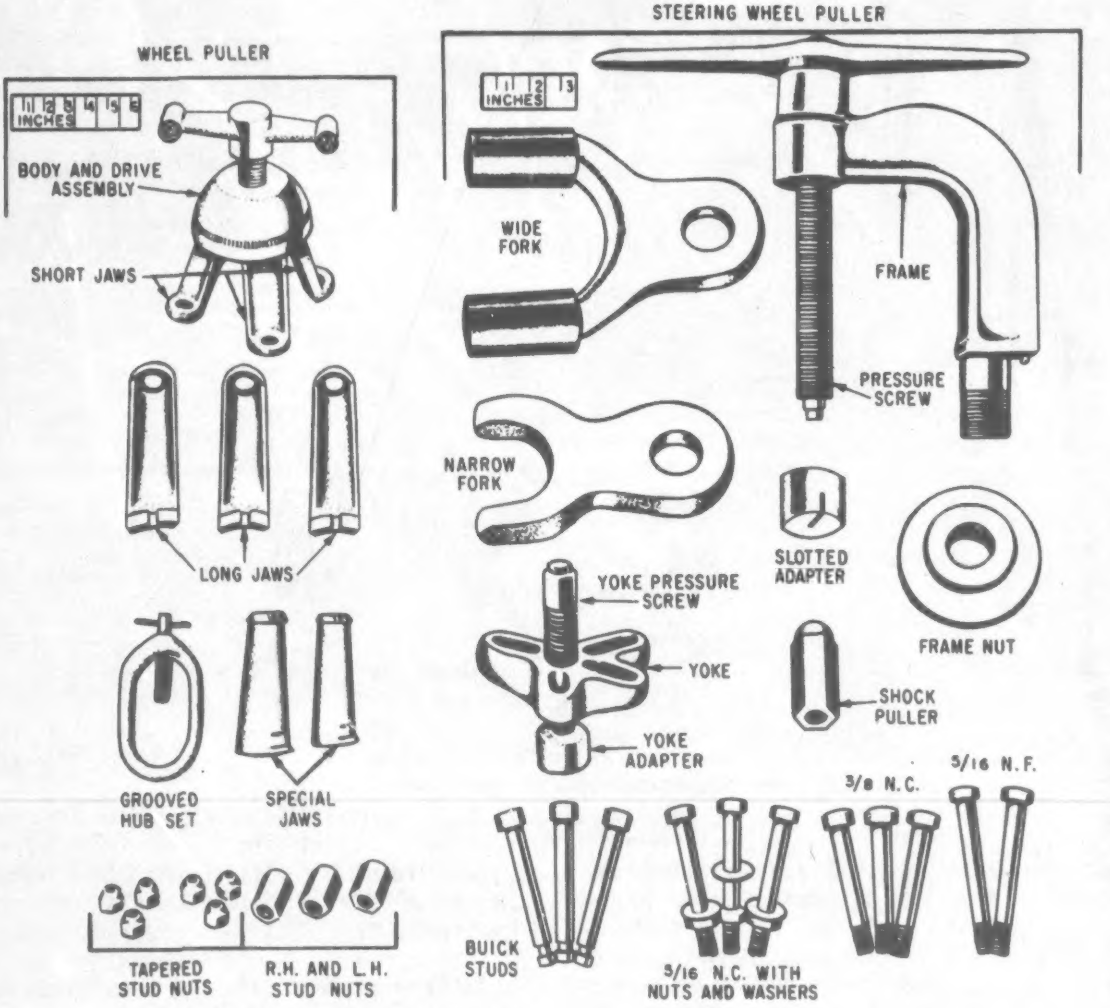
Figure 7-38.—Push and pull puller set.

puller consists of a 13 1/2-inch steel slotted bar to receive two legs. A pressure screw in the center of the bar is 13 inches long, having a diameter of 1 inch and threaded. This puller is universal and versatile with the use of bearing pulling attachment, bearing cup pulling attachment, sheave puller attachment, threaded adapters, step plate adapters, additional legs, and many other special adapters. This puller is capable of removing or replacing bearings, gears, pinions, pulleys, wheels, and bushings, and has many other uses.

UNIVERSAL-TYPE STEERING WHEEL PULLER (figure 7-39).—This complete set consists of all the units necessary for removal of steering wheels from all cars and trucks from early models up to the present.

UNIVERSAL WHEEL PULLER SET (figure 7-39).—This set consists of a body and drive assembly that receives either three long jaws, three short jaws, or a special grooved hub set for Ford passenger cars. The interchangeable jaws pivot and swing to any desired bolt circle. Tapered, and right- and left-hand threaded stud nuts complete the set, all of which are carried in a metal case. It is capable of pulling any demountable wheel hub for any passenger car and most lightweight trucks. A chain-type wheel puller also is available that has a 1-ton pulling capacity (not illustrated).

UNIVERSAL CYLINDER SLEEVE PULLER (figure 7-40).—This puller will pull the cylinder sleeves on more than 200 makes and models of trucks and tractors. It is adjustable to provide clearance regardless of the position of


WHEEL PULLER
INCHES
BODY AND DRIVE ASSEMBLY
SHORT JAWS
LONG JAWS
GROOVED HUB SET
SPECIAL JAWS
TAPERED STUD NUTS
R.H. AND L.H. STUD NUTS
STEERING WHEEL PULLER
INCHES
WIDE FORK
FRAME
PRESSURE SCREW
NARROW FORK
SLOTTED ADAPTER
FRAME NUT
YOKE PRESSURE SCREW
YOKE
SHOCK PULLER
YOKE ADAPTER
3/8 N.C.
5/16 N.F.
BUICK STUDS
5/16 N.C. WITH NUTS AND WASHERS

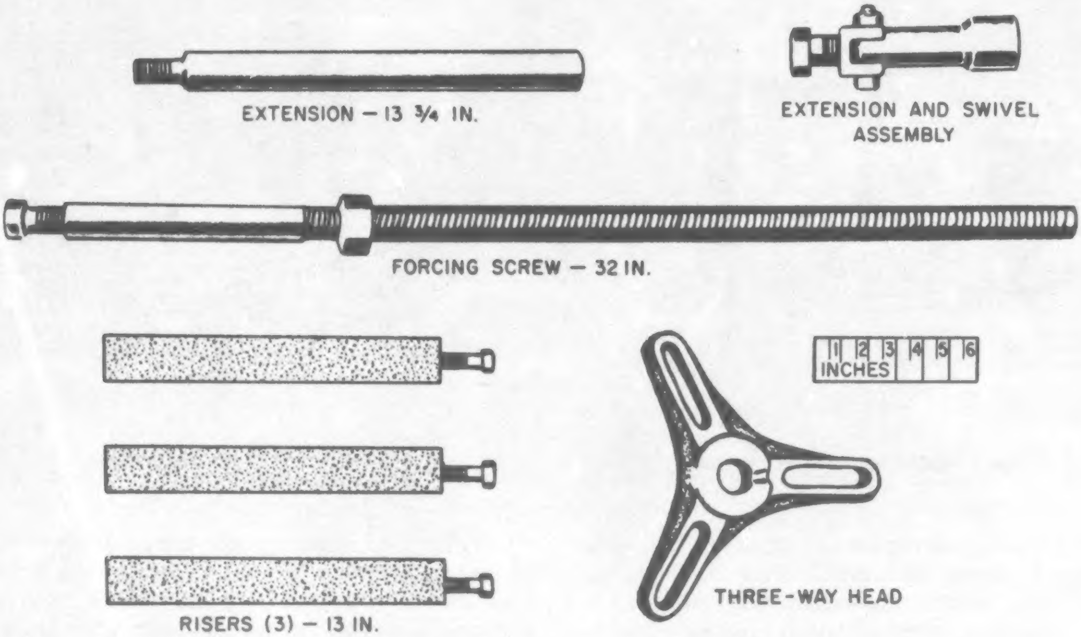
81.29

Figure 7-39.—Steering wheel and wheel pullers.

the cylinder studs and to simplify centering the tool over the bore. This puller is used in conjunction with four adapter plates supplied with the puller. The combination is capable of pulling cylinder sleeves 4 1/4, 4 1/2, 4 3/4 and 5 3/4 inches in diameter.

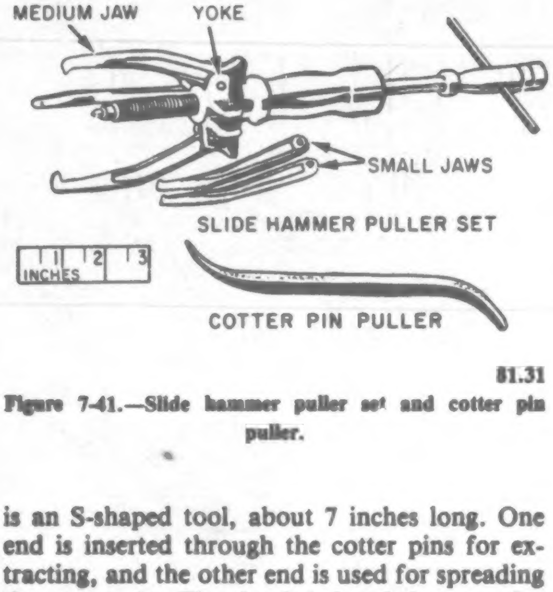
SLIDE HAMMER PULLER SET (figure 7-41).—This set is a universal-type puller equipped with a two-and three-way yoke, and three medium jaws for outside pulls and two small jaws for inside pulling. The small jaws can be inserted through a 1/2-inch opening. The capacity of the medium jaws is 2 1/4 inches. The slide hammer puller also is equipped with a locking feature which holds the jaws open or locks them on the work.

COTTER PIN PULLER (figure 7-41).—This is used to install or to remove cotter pins. It


EXTENSION – 13 ¾ IN.
EXTENSION AND SWIVEL ASSEMBLY
FORCING SCREW – 32 IN.
1 2 3 4 5 6 INCHES
RISERS (3) – 13 IN.
THREE-WAY HEAD

81.30

Figure 7-40.—Cylinder sleeve puller.


MEDIUM JAW
YOKE
SMALL JAWS
SLIDE HAMMER PULLER SET
1 2 3 INCHES
COTTER PIN PULLER

81.31

Figure 7-41.—Slide hammer puller set and cotter pin puller.

is an S-shaped tool, about 7 inches long. One end is inserted through the cotter pins for extracting, and the other end is used for spreading the cotter pin. The shank is beveled square for easy handling and firm grip.

Use of Pullers

Because pullers are used in nearly the same way regardless of whether they are to be used on engines, transmission, or chassis, some representative pulling situations will be explained in this chapter.

When using any puller, place it firmly in position and secure it if locking devices are part of the puller. Make certain the puller will not slip off suddenly while under strain. Check all gripping edges and threads of a puller for damage before using it. Use the proper size wrench for turning the pressure screw or nut to avoid rounding the corners of the nut or of the screwhead. Use the proper size puller for the job.

The universal push and puller set is probably the best all-around puller combination available. Several combinations of its components are discussed and illustrated.

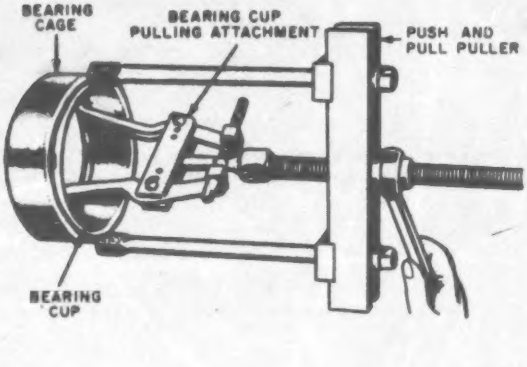

BEARING CAGE
BEARING CUP PULLING ATTACHMENT
PUSH AND PULL PULLER
BEARING CUP
81.32

Figure 7-42.—Removing bearing cup.

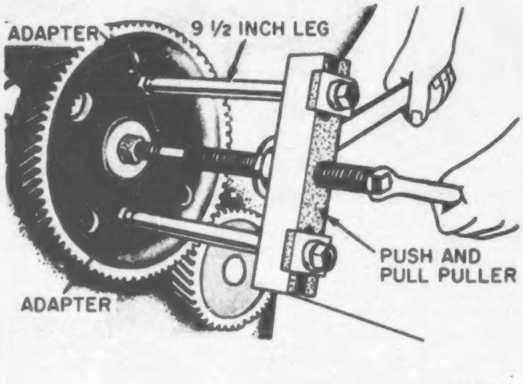

ADAPTER
9 1/2 INCH LEG
PUSH AND PULL PULLER
ADAPTER
81.34

Figure 7-44.—Pulling a camshaft gear.

Figure 7-42 shows a combination of the push and pull puller and the bearing cup pulling attachment used to remove a bearing cup from a cage. The same combination is used to install it back in the cage, as shown in figure 7-43.

To pull a camshaft gear, use the push and pull puller with 9 1/2-inch legs with two adapters as shown in figure 7-44. Here the camshaft gear is being removed without removing the camshaft from the engine. A protective plate should be used under the forcing screw to protect the end of the camshaft.

Figure 7-45 illustrates the use of the bearing pulling attachment and a pair of forcing bolts used to remove a bevel pinion shaft from a transmission case. The forcing bolts bear against the case and force the pinion shaft out. Tighten forcing bolts alternately to obtain a uniform even pull to prevent cocking.

In figure 7-46 a roller bearing assembly is being removed from a transmission shaft with a

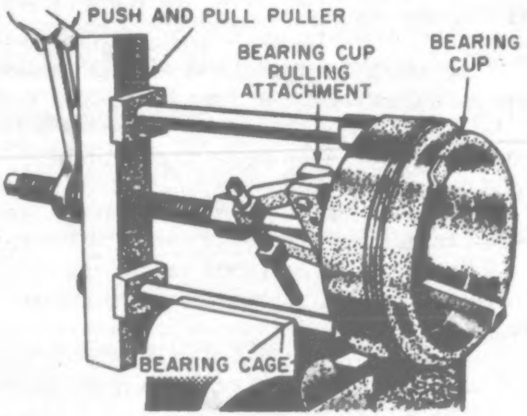

PUSH AND PULL PULLER
BEARING CUP PULLING ATTACHMENT
BEARING CUP
BEARING CAGE
81.33

Figure 7-43.—Installing bearing cup.

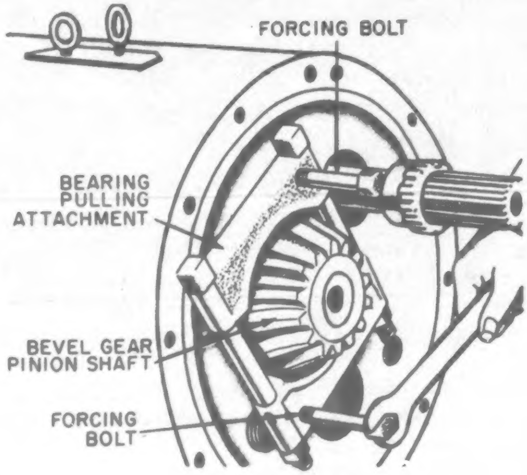
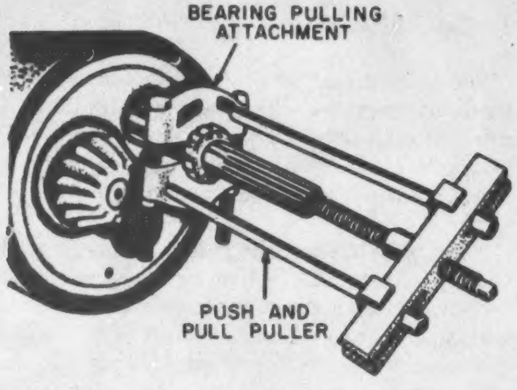

FORCING BOLT
BEARING PULLING ATTACHMENT
BEVEL GEAR PINION SHAFT
FORCING BOLT
81.35

Figure 7-45.—Pulling a bevel gear pinion shaft.



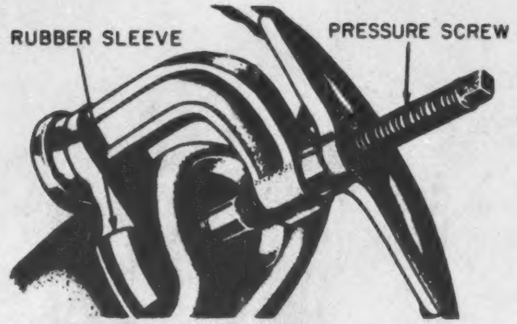
81.36

Figure 7-46.—Pulling a bearing.

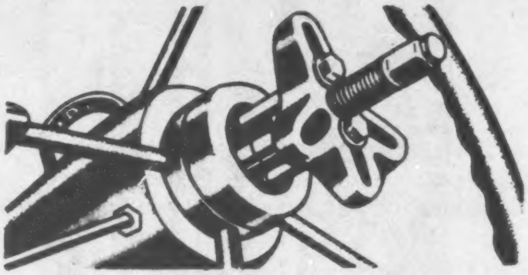
combination of the bearing pulling attachment and the push and pull puller.

The steering wheel puller set (figure 7-39) handles the job of pulling the steering wheels on all cars and trucks. The yoke puller and its related parts are used to pull the newer models, since they have tapped wheel hubs. The fork puller and its related parts are used on older models. The pressure screw in the frame puller is threaded its entire length and works through a key. The narrow fork has a brass insert and the wide fork has rubber sleeves to protect the steering column. Adapters protect the shaft from damage. Figure 7-47 illustrates the use of the wide fork and frame puller on older type hubs and the yoke puller removing a late model steering wheel.

The cylinder sleeve puller (figure 7-40) is adjustable to provide clearance regardless of the number or position of the cylinder head studs, and to accurately center the tool over the bore (figure 7-48). Four adapter plates are supplied with the puller set which cover sleeves from 4 1/4 to 5 3/4 inches in diameter. The adapter is positioned so that the cylinder sleeve rests on the edges of the adapter. The puller swivel assembly is inserted from the top and screwed into the adapter. By tightening the forcing screw, a steady force is applied which will pull the sleeve out of the cylinder.



A—WIDE FORK AND FRAME USED ON OLDER TYPE HUBS



B—YOKE AND SCREW ASSEMBLY USED ON LATE MODEL HUBS

81.37

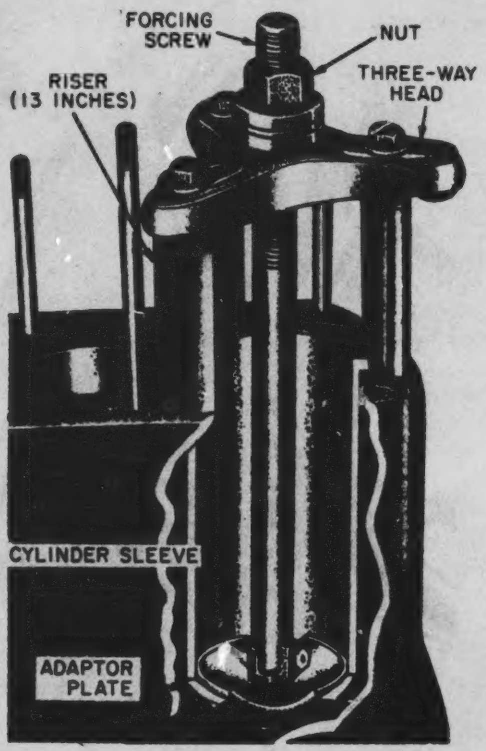
Figure 7-47.—Using steering wheel puller set.

Care of Pullers

Keep pullers clean at all times. Grease or oil on the gripping edges will make the tool slip. Clean all pullers after use and store them so that the threads and gripping edges will not become damaged. Make certain all attachments and adapters are stored with the basic puller and do not become separated.

SPECIFICATIONS

In your work around the shop, you will often hear the term "specifications" or "specs." Specifications refer to the measurements of the parts of a vehicle. For instance, an automobile manufacturer's shop manual may specify that the piston-ring gap should be .002 inch, or that intake valve stem to bore clearance should be .001 to .003 inch.



81.38
Figure 7-48.—Using a cylinder sleeve puller.

ENGINE TESTING EQUIPMENT

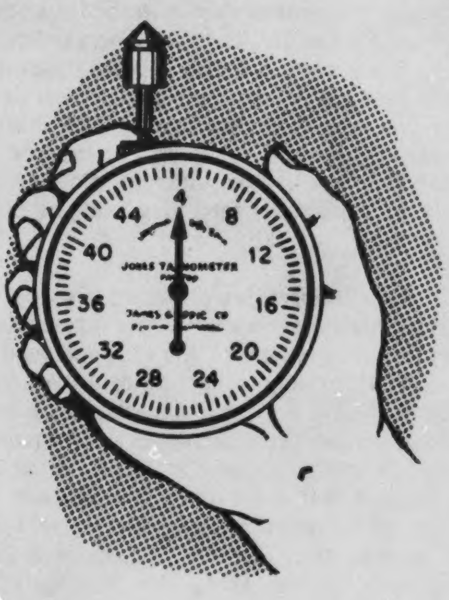
Satisfactory performance and dependability are what every equipment operator desires most from his vehicle. It is the mechanics' obligation, therefore, to perform all the service necessary to ensure or restore this performance and dependability. Each time you are confronted with a vehicle against which an operator has registered a performance complaint, you must know the cause of the difficulty before determining what corrective measures must be taken. In most shops, the Navy provides accurate and dependable test equipment. The proper use of this equipment provides the quickest and surest means of finding out what is wrong and where the fault lies with the vehicle operation.

TACHOMETER

A tachometer is a speed indicating device used to measure the rpms (revolutions per minute) of a rotating shaft. Since many engine tests are made at specified engine speeds, you should learn how to use a tachometer.

Tachometers may be either manually or electrically operated. When using the manual tachometer on a shaft, make sure the shaft turns the same speed as the crankshaft or you will not get an accurate reading of engine rpms. In many instances it is easy to take tachometer readings off the camshaft or fuel pump shaft. On 4-cycle engines these shafts run one-half engine speed. Consequently any tachometer reading taken from these shafts must be doubled to get the true engine rpm.

A manual tachometer (figure 7-49) is used by holding its tip against the end of a rotating shaft. Make sure the end of the shaft is clean and that there is no slippage between the tip of the tachometer and the shaft. Read the speed directly on the tachometer dial, which is



227.4
Figure 7-49.—Manually operated tachometer.

calibrated in revolutions per minute. No timing is necessary as variations in speed will be reflected by movement of the pointer on the dial during the test.

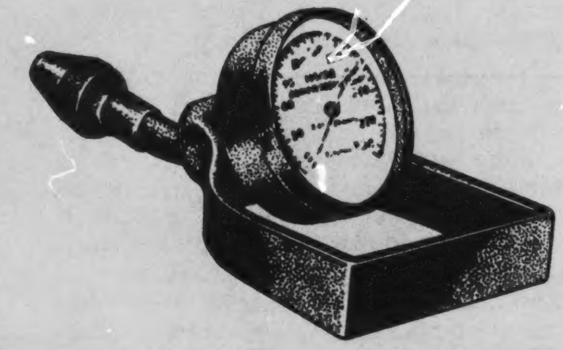
The electric tachometer is connected to the ignition primary circuit to measure the number of times per minute the primary circuit is interrupted. It then translates this information into engine rpm.

The electric tachometer may have a selector switch on it that can be turned to correspond with the number of lobes on the distributor cam. The number of lobes will be the same as the number of cylinders in the engine. For the proper method of hooking up and using the electric tachometer, check the manufacturer's instructions for the tachometer you are using.

COMPRESSION TESTER

The cylinder compression tester (figure 7-50) is used to measure cylinder pressure in psi (pounds per square inch) as the piston moves to TDC (top dead center) on the compression stroke.

To use the compression tester, remove all the spark plugs from the engine. Hold or screw the tester fitting tightly in one of the spark plug holes. Crank the engine with the starting motor until it makes at least four complete revolutions. Notice the maximum compression as indicated by the needle on the compression tester dial. Repeat this procedure until the compression has been checked on all cylinders of the engine.



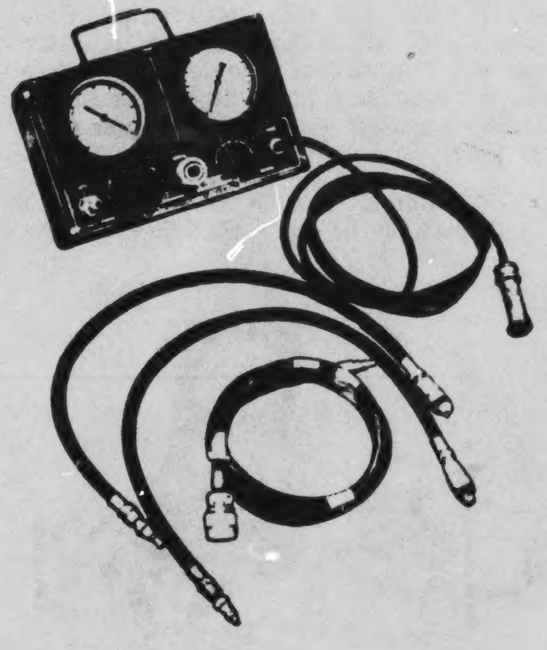
81.1X

Figure 7-50.—Cylinder compression tester.

The compression of the engine must meet the manufacturer's specifications in order for the engine to develop rated power. This means that there must be no leakage in the cylinder. The intake and exhaust valves, the gaskets, and piston rings must all function properly and allow no leakage for full power output. An engine with low compression in one or more cylinders will have uneven power strokes which result in rough operation, and in a proportionate reduction in performance.

CYLINDER LEAKAGE TESTER

The cylinder leakage tester will, when properly used, give a good indication of the condition of an engine cylinder. This tester (figure 7-51) applies air to the cylinder at controlled



227.5

Figure 7-51.—Cylinder leakage tester.

volume and pressure, and measures the percentage of air leakage. Even the smallest leak can be easily detected.

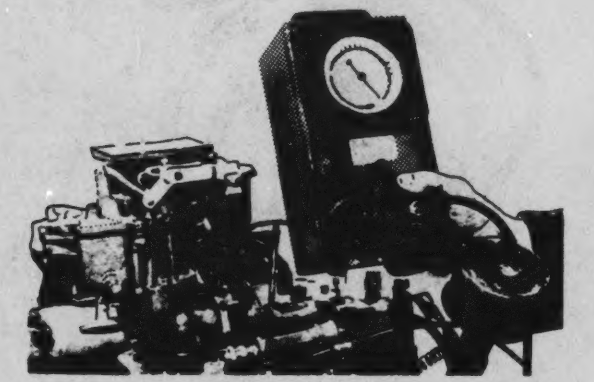
It is normal for a small amount of air to escape past the rings into the crankcase. However, any leak through an intake valve, an exhaust valve, head gasket, head, block, or excessive leakage past the rings, indicates trouble which must be corrected before satisfactory engine performance can be expected.

To use the cylinder leakage tester, hook it to the cylinder as recommended by the equipment manufacturer. Listen for escaping air through the carburetor, the exhaust or tail pipe, and the crankcase filler pipe. Check for air bubbles in the radiator.

VACUUM GAGE

The vacuum gage (figure 7-52) provides a means of testing intake manifold vacuum, cranking vacuum, fuel pump vacuum, and booster pump vacuum. Properly used, the vacuum gage will indicate if other tests are necessary. The vacuum gage does not replace other test equipment, but rather supplements it, and makes a diagnosis of engine trouble more conclusive.

The manifold vacuum test provides an overall check on the engine condition based on comparison of reading obtained with known standards for the engine being tested. Any loss of power or efficiency in the engine will affect the manifold vacuum reading.



227.6

Figure 7-52.—Manifold vacuum gage connection.

Vacuum gage readings are usually taken with the engine running and must be accurate to be of any value. Therefore, when connecting the gage to the intake manifold, be sure the connection is leakproof. Also, before the connection is made, make sure the openings to the gage and intake manifold are free from dirt or other restrictions.

Experience is the best guide in determining the normal vacuum for any given engine. Normal manifold vacuum ranges from 15 to 22 inches on various engines when the test is being made at sea level pressures. The average reading will drop approximately 1 inch for each 1,000 feet above sea level. The reading obtained is the difference between normal atmospheric pressure and the reduced pressure within the manifold of the running engine. This difference in pressure forces the air-fuel (gasoline) or air (diesel) mixture into the cylinders. For this reason, any abnormal vacuum gage reading will indicate improper operation. The action of the pointer on the gage is the most important factor in interpreting the reading to determine the internal trouble of the engine.

When you open and close the throttle suddenly, the vacuum reading should first drop to about 2 inches with the throttle open and then come back to a high of about 24 inches before settling back to a steady 18 inches as the engine idles. (See figure 7-53.) This is normal for an engine in good operating condition.

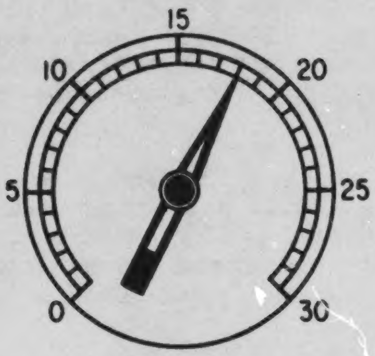
If the gage reading drops to around 15 inches at a running speed of about 40 mph (miles per hour) and remains there, it indicates compression leaks between the cylinder walls and the piston rings, or power loss caused by incorrect ignition timing. A vacuum gage needle indicating a steady 10, for example, usually means that the valve timing of the engine is incorrect. Below normal readings that change slowly between two positions, such as 14 to 16 inches, could point to a number of troubles, which might be any of the following: (1) improper carburetor idling adjustments, (2) maladjusted or burned breaker points, (3) spark plugs with the electrodes set too close.

A sticking valve could cause the gage needle to bounce from a normal steady reading to a lower reading and back to normal. A broken or weak valve spring would cause a wide variation of the needle as the engine is accelerated. A loose intake manifold, or a leaking gasket between the carburetor and manifold, would show a steady low reading on the vacuum gage. (See figure 7-54.)

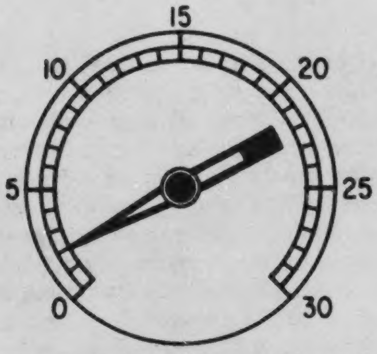
You must remember that manifold vacuum tests only help you locate trouble. They are not always conclusive, but through experience and skill and correct interpretation of the readings, in conjunction with the compression test results, you can usually diagnose engine behavior correctly.

EXHAUST GAS ANALYZER

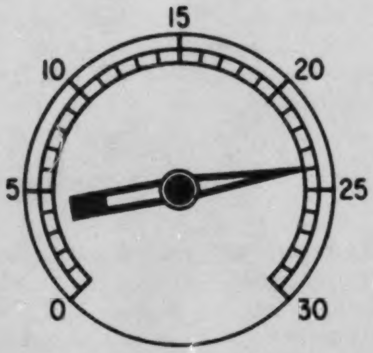
An exhaust gas analyzer (combustion efficiency tester) checks the exhaust gas to determine what percentage of the gasoline has not been burned. Combustion efficiency is a very reliable indication of carburetor system operation on a mechanically sound, properly tuned engine with a good ingition system. If your shop has one of these instruments, learn to use it properly.



NORMAL IDLE



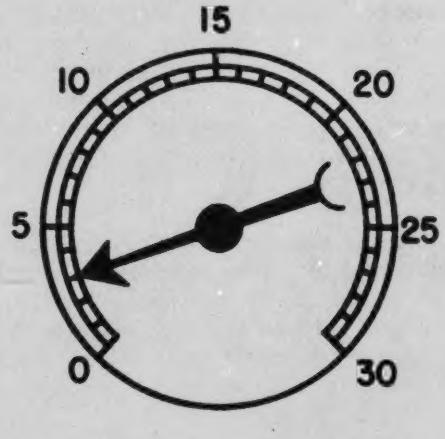
THROTTLE OPENED SUDDENLY



MAX READING AFTER
THROTTLE IS OPENED SUDDENLY

227.7

Figure 7-53.—Approximate vacuum gage readings on a normal operating engine.



2.27

Figure 7-54.—Low vacuum gage reading indicating a leak in the intake manifold.

Combustion efficiency is tested by utilizing exhaust gas samples picked up at the tailpipe to determine the fuel to air ratio. This information is indicated on an electric meter. The pointer on the meter is affected by the amount of hydrogen and carbon in the exhaust gas that runs through the analyzer. Check the manufacturer's manual for the equipment you are using to interpret the reading on the meter of the analyzer. When the readings are correctly interpreted, you can tell whether the carburetor needs adjustment.

Before testing, determine that both compression and ignition of the engine to be tested are in good condition, and that the exhaust system does not leak. Smoke from an engine that is burning oil does not materially affect the accuracy of an exhaust analyzer during the test. Repeated use of a combustion efficiency tester on oil burning engines will eventually decrease its sensitivity because of oil fouling.

DYNAMOMETERS

A dynamometer is an instrument for measuring the horsepower an engine develops. This instrument consists of a resistance creating device, such as an electric armature revolving in a magnetized field. A paddle wheel revolving in a fluid may also be used to absorb the energy.

An engine dynamometer may be used to test an engine that has been removed from the vehicle it drives. If the engine does not develop the manufacturer's recommended horsepower and torque at specific rpms, you know there is need for further adjustments and/or repairs on the engine.

The chassis dynamometer (figure 7-55) is commonly used for automotive service, since it can give a very quick report on engine conditions by measuring output at various speeds and loads. This type of machine is very useful in shop testing and adjusting automatic transmissions.

On the chassis dynamometer, the driving wheels of the vehicle are placed on rollers. The engine drives the wheels and the wheels drive the rollers. By loading the rollers varying amounts and by running the engine at different rpms, nearly all normal driving conditions can be simulated. The tests and checks can be made without the interference of body noises, such as you would have when checking the vehicle on the road.

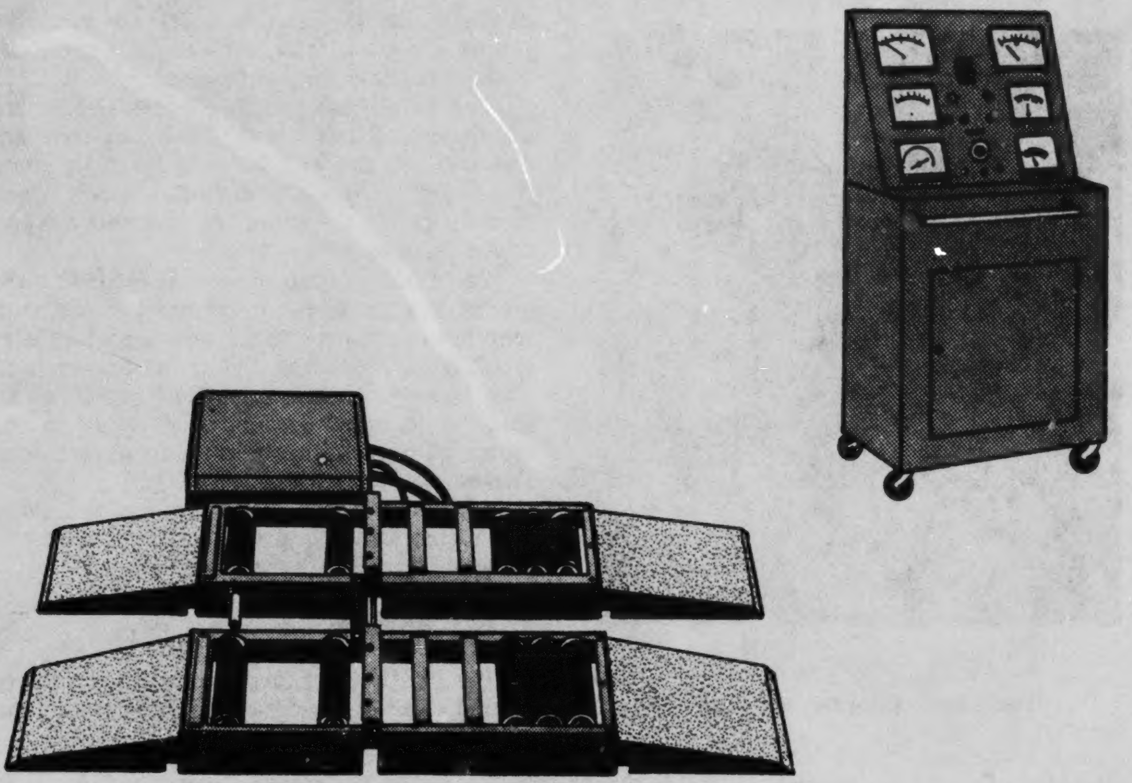
Be sure you read and understand the operator's manual on the dynamometer before attempting to use it. The machine is rather complex and can be damaged by improper handling; like all equipment, it is worthless if not in working order.

IGNITION STROBOSCOPE (TIMING LIGHT)

Later in this manual you will learn how the air-fuel or air mixture is ignited. For the present, it is enough to know that ignition must take place at the proper instant. An instrument called an ignition timing light (figure 7-56) is used to check engine timing on a gasoline engine. A timing light is basically a neon light powered by the battery of the vehicle being tested. The vehicle being timed will have a timing mark on the flywheel or the crankshaft pulley. A timing pointer is fastened to some stationary part of the engine. If the ignition is properly timed, the timing mark will line up with the fixed pointer each time the timer flashes. The flash occurs the instant the spark plug from cylinder number 1 fires. Later in this manual you will learn more about engine timing.

VALVE REPAIR EQUIPMENT

Valve repair equipment is composed of an assortment of machine tools and components that are designed for reconditioning valves of internal combustion engines, in accordance with engine manufacturer's specifications. Reconditioning valves is a precision job. Therefore, if you are in doubt about how to use a valve repair tool, consult the equipment manufacturer's instructions or have an experienced mechanic show you. In any case, find out how to properly use valve repair equipment before trying to do a complete valve job by yourself.



226.25

Figure 7-55.—Chassis dynamometer.

VALVE REFACER

The valve refacing machine (figure 7-57) is used to remove small pits or burns from the valve face. This is accomplished by clamping the valve stem in the chuck of the refacing machine and bringing the rotating grinding wheel into contact with the seating face of the valve.

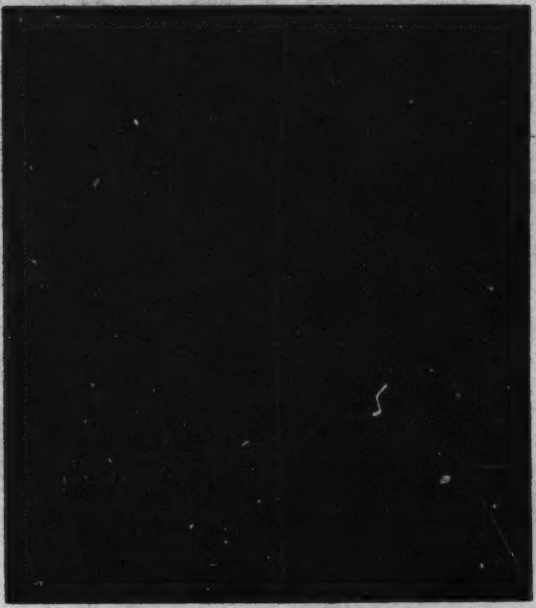
Valve refacing machines have attachments for dressing their grinding wheels, truing tappets, squaring valve stems, and for grinding valve rocker arm faces.

VALVE SEAT GRINDER

Valve seat grinding equipment (figure 7-58) consists of a driver, pilots, grinding stones, a stone dressing stand, and stone sleeves.

The driver provides the power for valve seat grinding. There are different kinds and designs you may encounter, but one popular model employs an angular head design to permit easier handling in confined spaces. Most drivers incorporate a positive vibrating action, which lifts the grinding stone from the seat once each revolution. This minimizes stone loading, speeds up grinding, and reduces stone wear.

Most valve guide pilots are of the self-centering type. Their function is to provide a rigid axis for the grinding stone sleeves, so that the valve seats are refaced concentric with valve guides. The self-centering pilots have two machined tapers—one at the top of the shank to fit the top of the valve guide, and one at the bottom, to expand a split sleeve in the lower end



2.42

Figure 7-56.—Using the timing light.

of the guide. (See figure 7-59.) To select the proper size pilot, refer to valve guide specifications of the engine manufacturer.

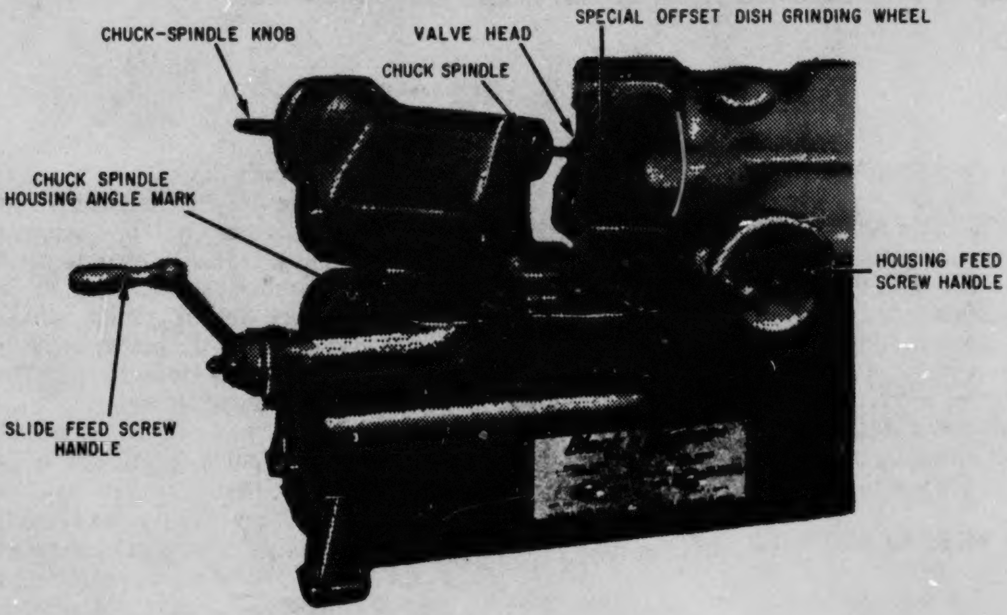
The valve seat grinding stone sleeves are attachments that fit over the pilot. They are threaded on one end for attaching the stone (figure 7-60). The upper end has a socket which forms a universal joint connection with the end of the driver spindle.

Valve seat grinding stones are made in three grades: one grade is for the average cast iron seats found in most engines; another is for faster grinding of hard steel, stellite, and other hard alloy inserts; a third is for "finish grind" on all seats. A threaded steel bushing is cast in the center of each stone to thread on the stone sleeves.

After the stones are placed on the stone sleeve, they should be dressed on the stone dressing stand to establish a true angle to the pilot.

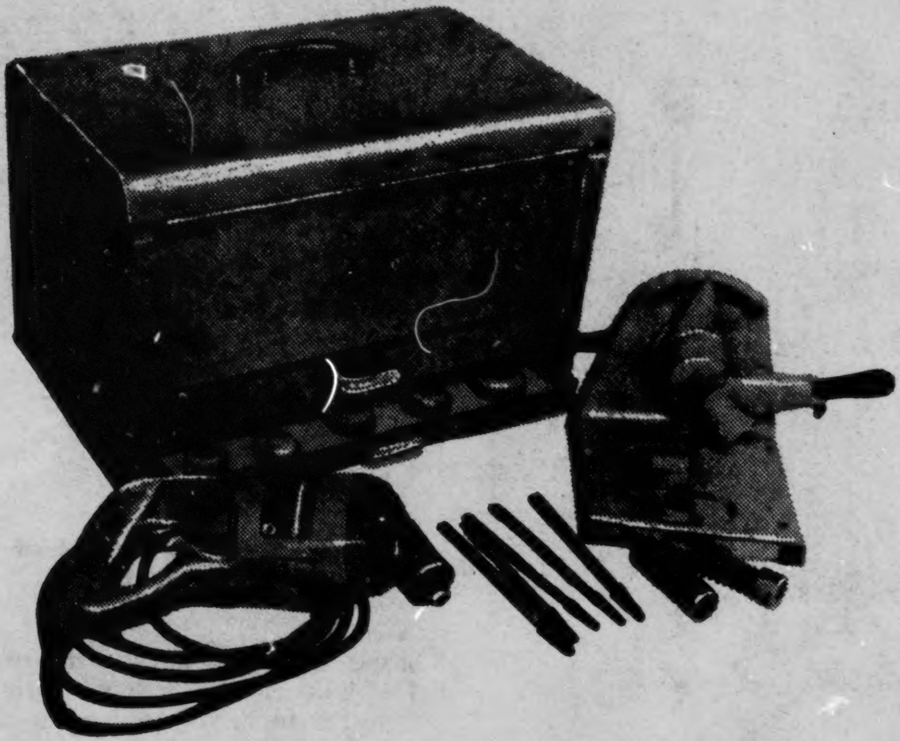
VALVE LAPPER

The final process involved in fitting a newly ground valve to its seat consists of rotating the


CHUCK-SPINDLE KNOB
VALVE HEAD
SPECIAL OFFSET DISH GRINDING WHEEL
CHUCK SPINDLE
CHUCK SPINDLE HOUSING ANGLE MARK
HOUSING FEED SCREW HANDLE
SLIDE FEED SCREW HANDLE

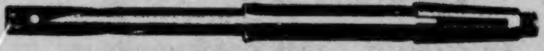
226.36

Figure 7-57.—Valve refacing machine.



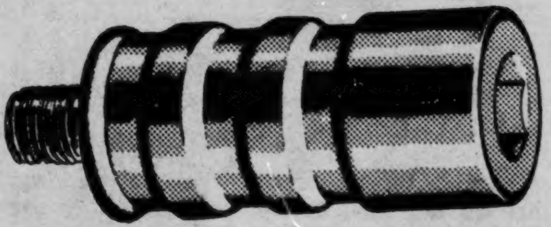
227.9

Figure 7-58.—Valve seat grinding equipment.



2.29X

Figure 7-59.—Self-centering valve guide pilot.



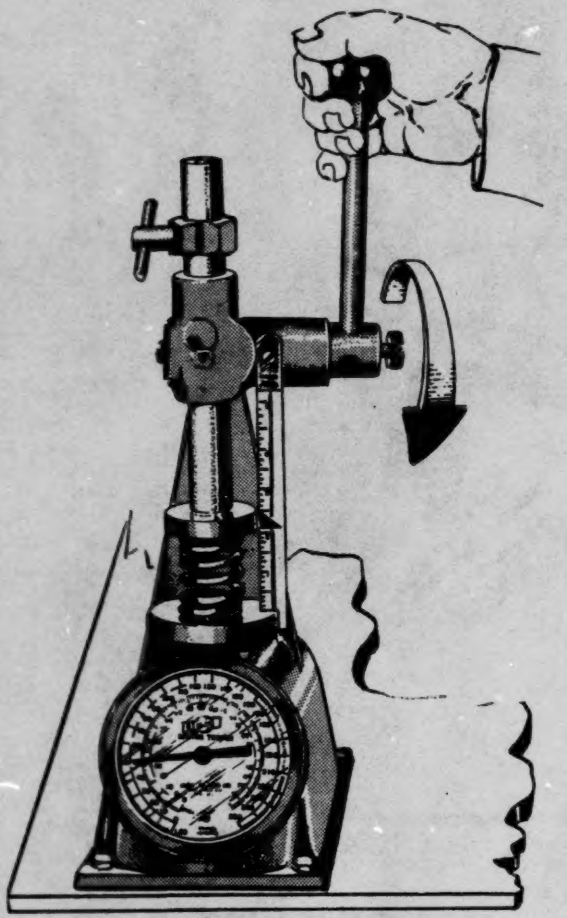
2.30X

Figure 7-60.—Valve seat grinding stone sleeve.

valve in its closed position, thus rubbing the valve seating face against the valve seat. This is called lapping, and is done with a valve lapper.

VALVE SPRING TESTER

A valve spring tester (figure 7-61) is used to test valve springs for proper tension. A valve spring that is too weak will not seat the valve properly and thus cause it to burn. A spring that is too strong will cause undue wear on the valve operating mechanism. The engine manufacturer's manual will give the proper tension that is



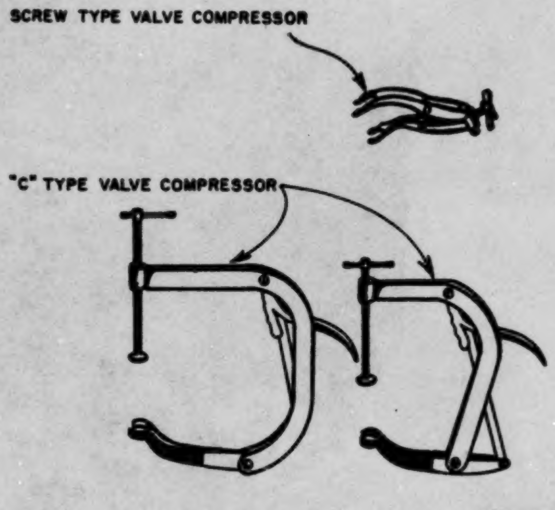
227.10

Figure 7-61.—Valve spring tester.

required of the valve springs. Any valve springs that do not have the proper tension or are warped or short, should be discarded.

VALVE SPRING COMPRESSOR

Valve spring compressor is the name given to the tool that compresses the valve spring so the retaining locks can be removed from the valve stem. Two types of valve spring compressors (figure 7-62) are generally used in the Navy. The "C" clamp compressor is used on overhead valve engines and has a screw adjusting post that adapts the tool to various valve stem lengths. The jaws on the bottom of the tool are adjustable to the valve spring diameters.



227.11

Figure 7-62.—Valve lifters for L-head and valve-in-head engines.

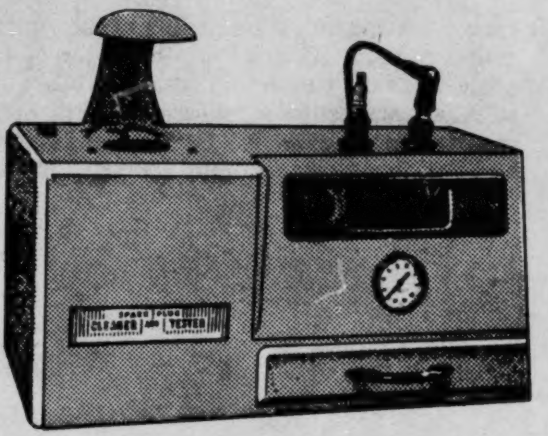
The screw-type valve spring compressor, shown in figure 7-62, is generally used on L-head engines having straight stemmed valves. Top jaws adjust to various spring diameters.

INJECTOR NOZZLE TESTER

An incorrect nozzle opening pressure or incorrect injector pop pressure will influence engine efficiency and performance. The exact effect will vary according to the type of combustion space served. When opening pressure is greater than the specified value, it tends to decrease the amount of fuel injected, and also tends to retard the start of injection. A low nozzle opening pressure decreases the atomization of the fuel at low speeds, and in extreme cases will cause dribble. It also tends to increase the amount of fuel injected, which will cause a smoky exhaust from the engine cylinder affected. The best protection against trouble from this source is a periodic check of the nozzle or injector with the appropriate tester. One type of test stand is shown in figure 7-63. Test stands will vary, depending upon the manufacturer, but all operate on the same principle. The type of test stand illustrated in figure 7-63 is intended primarily for activities doing a considerable amount of nozzle and injector reconditioning work.

Tests that may be performed on this type of fixture are: spray tip orifice test, valve opening pressure test, and holding pressure test. Complete details on test procedures should be obtained from the appropriate fuel injector equipment maintenance manual.

When a tester is used, keep in mind that the penetrating power of the fuel oil spray is sufficient to drive oil through your skin. Since this can cause blood poisoning, it is essential that all parts of the body be kept out of line of the fuel spray.

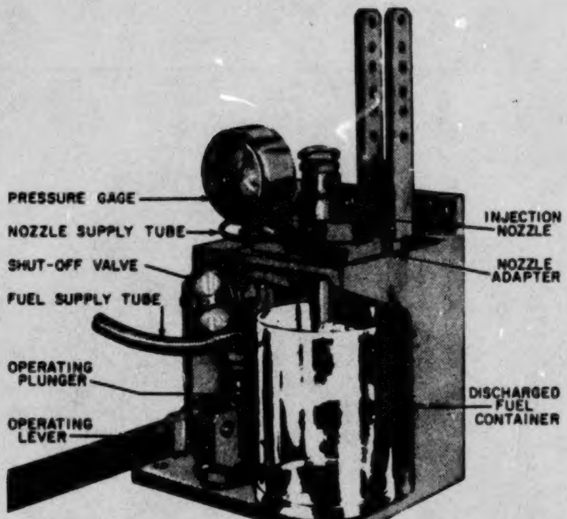


227.12

Figure 7-64.—Spark plug cleaner and tester.

SPARK PLUG CLEANER AND TESTER

A spark plug cleaner (figure 7-64) uses air and sand to sand blast the electrode or cylinder end of the plug free of carbon deposits and other undesirable material. A box-like cover encloses the cleaning and testing equipment. Air is connected to the cleaner part. This air blasts the sand against the plug to clean it. The plug must be rotated to ensure all of the cylinder end is thoroughly cleaned. The plug should be cleaned with solvent and dried before using the sand blaster.



121.14X

Figure 7-63.—Universal injector testor.

After cleaning, the plug and a new plug are screwed into the tester for comparison under pressure. The test comparison chamber has a small window with a mirror under it set at an angle so one can observe the spark jumping the electrodes. With the high-tension lead connected and the plug firing, the pressure is raised until the plug stops firing. Then the pressure is decreased until the plug fires steadily; at this point, a reading of the pressure is taken. The same procedure is repeated with the new plug and a comparison is reached.

SUMMARY

No maintenance task whether it is to repair, replace, or adjust a particular component can be accomplished without tools. The proper use of these tools and an understanding of their application to the specific job has been one of the goals of this chapter. Continuous care to safeguard and use tools properly will assure that each maintenance task will be completed quickly and will conform to the Navy's highest standards. Your greatest asset in doing your job is your knowledge of, and your proficiency in, the care and use of tools. We suggest that you reread the applicable parts of this chapter whenever you need to relate a tool to any new job you are to do.

Chapter 8

HARDWARE, FUELS, LUBRICANTS, AND HYDRAULIC FLUIDS

Hardware and petroleum products have always been important to modern military operations. These products are no less important to the AS. This chapter covers these products as related to aviation support equipment.

HARDWARE

Because of the small size of most hardware items, such as seals, packings, bolts, safety wire, and other hardware, their importance is often overlooked. However, the safe and efficient operation of any ground support equipment is greatly dependent upon correct selection and use of this hardware.

SEALS

Seals are used throughout the systems of ground support equipment to minimize leakage of fluids and gases. Seals may be made up of packings or gaskets. Packings are usually in the shape of O-rings or other shapes for use on sliding or moving assemblies, and gaskets are seals between nonmoving fittings and bosses on support equipment.

O-RINGS

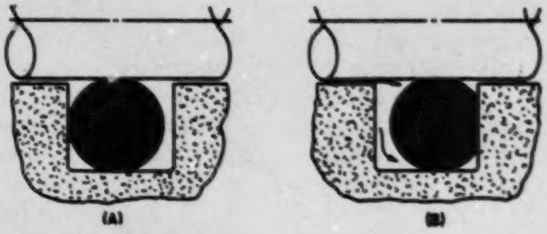
Most O-rings used in support equipment installations are made of synthetic rubber. They are used in units that contain moving parts, such as actuating cylinders, selector valves, etc.

The O-ring packing seals effectively in both directions. This sealing is accomplished by distortion of its elastic compound. View (A) in figure 8-1 shows an O-ring of the proper size installed in a grooved seat. Notice that the clearance for the O-ring is less than its free outer diameter. The cross section of the O-ring is squeezed out of round prior to the application of pressure. In this manner, contact is ensured with the inner and outer walls of the passage under static (no pressure) conditions.

(B) in figure 8-1 shows the action of the O-ring when pressure is applied. It should also be noted, in figure 8-1, that backup rings are not installed. In hydraulic systems where components are subjected to 1,500 psi and below, AN6227, AN6230, and MS28775 packings are used. In such installations, backup rings are not required although desirable. In systems with pressures up to 3,000 psi, backup rings are used in conjunction with the packings.

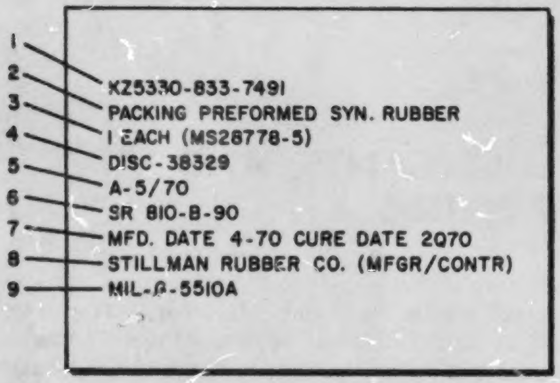
O-Ring Identification

O-rings are manufactured according to Military Specifications and can be best identified from the technical information printed on the O-ring package. (See figure 8-2.) The size cannot be positively identified by visual examination without the use of special equipment. For this



194.71

Figure 8-1.—O-rings properly installed.



KZ5330-833-7491
PACKING PREFORMED SYN. RUBBER
1 EACH (MS28778-5)
DISC-38329
A-5/70
SR 810-B-90
MFD. DATE 4-70 CURE DATE 2Q70
STILLMAN RUBBER CO. (MFGR/CONTR)
MIL-P-5510A

1. Stock number.
2. Nomenclature.
3. Part number.
4. Contract number.
5. Preservation.
6. Rubber composition number.
7. Date of manufacture and cure date.
8. Manufacturer.
9. Military specification number.

194.72

Figure 8-2.—O-ring package identification.

reason, O-rings are made available in individual hermetically sealed envelopes labeled with all the necessary data. It is recommended that they be procured and stored in these envelopes.

NOTE: Colored dots, dashes, and stripes or combinations of dots and dashes on the surface of the O-ring are no longer used for identification of this type seal.

Figure 8-2 shows the information printed on the O-ring packages, essential to determining the intended use, qualifications, and age limitations. The manufacturer's cure date is one of the more important printed items listed on the package. This cure date is denoted in quarters. For example, the cure date 2Q71 indicates that the O-ring was manufactured during the second quarter of 1971. Synthetic rubber parts manufactured during any given quarter are not considered one quarter old until the end of the succeeding quarter. Most O-ring age limitation is determined by this cure date, anticipated service life, and replacement schedule.

Age limitation of synthetic rubber O-rings is based on the fact that the material deteriorates with age. O-ring age is computed from the cure date. The term cure date is used in conjunction with replacement kits which contain O-rings, parts, and hardware for shop repair of various components. O-ring cure dates also provide the bases for O-ring replacement schedules, which are determined by O-ring service life. The service life (estimated time of trouble-free service) of O-rings also depends upon such conditions as use, exposure to certain elements, both natural and imposed, and subjection to physical stress. Operational conditions imposed on O-rings in one component may necessitate O-ring replacement more frequently than replacement of identical O-rings in other components. Therefore, it is necessary to adhere to the recommended replacement schedule for each individual component. The age of O-rings in a spare part is determined from the assembly date recorded on the service or identification plate and/or on the exterior of the container. All O-rings over 24 months old should be replaced or, if nearing their age limit (24 months), should not be used for replacement.

O-Ring Storage

Proper storage practices must be observed to prevent deformation and deterioration of rubber O-rings. Most synthetic rubbers are not damaged by several years of storage under ideal conditions. However, most synthetic rubbers deteriorate when exposed to heat, light, oil, grease, fuels, solvents, thinners, moisture, strong drafts, or ozone (form of oxygen formed from electrical discharge). Damage by exposure is magnified when rubber is under tension, compression, or stress. There are several conditions to be avoided, including the following:

1. Deformation as a result of improper stacking of parts and storage containers.

2. Creasing caused by a force applied to corners and edges, and by squeezing between boxes and storage containers.

3. Compression and flattening, as a result of storage under heavy parts.

4. Punctures caused by staples used to attach identification.

5. Deformation and contamination due to hanging the O-rings from nails or pegs. O-rings should be kept in their original envelopes, which provide preservation, protection, identification, and cure date.

6. Contamination by piercing the sealed envelopes to store O-rings on rods, nails, or wire handling devices.

7. Contamination by fluids leaking from parts stored above and adjacent to O-ring surfaces.

8. Contamination caused by adhesive tapes applied directly to O-ring surfaces. A torn O-ring package should be secured with a pressure-sensitive, moisture-proof tape, but the tape must not contact the O-ring surfaces.

9. Retention of overage parts as a result of improper storage arrangement or illegible identification. O-rings should be arranged so the older seals are used first.

O-Ring Removal and Installation

The successful operation of a hydraulic system and the units within depends greatly upon the methods and procedures used in handling and installing hydraulic seals. These seals are comparatively soft and should not be subjected to any nicks, scratches, or dents. They should be kept free of dirt and foreign matter and should not be exposed to extreme weather conditions. When hydraulic seals are chosen for installation, they should not be picked up with sharp instruments, and the preservative should not be removed until they are ready for installation.

During the installation or removal of hydraulic seals, as well as other tasks, an AS technician's best friend is the correct tool. A variety of these tools may be used on any given job. Suggestions for fabricating typical tools for use in replacing and installing O-rings and backup rings are shown in figure 8-3. These tools should be fabricated from soft metal such as brass and aluminum; however, tools made from phenolic rod, plastics, and wood may also be used.

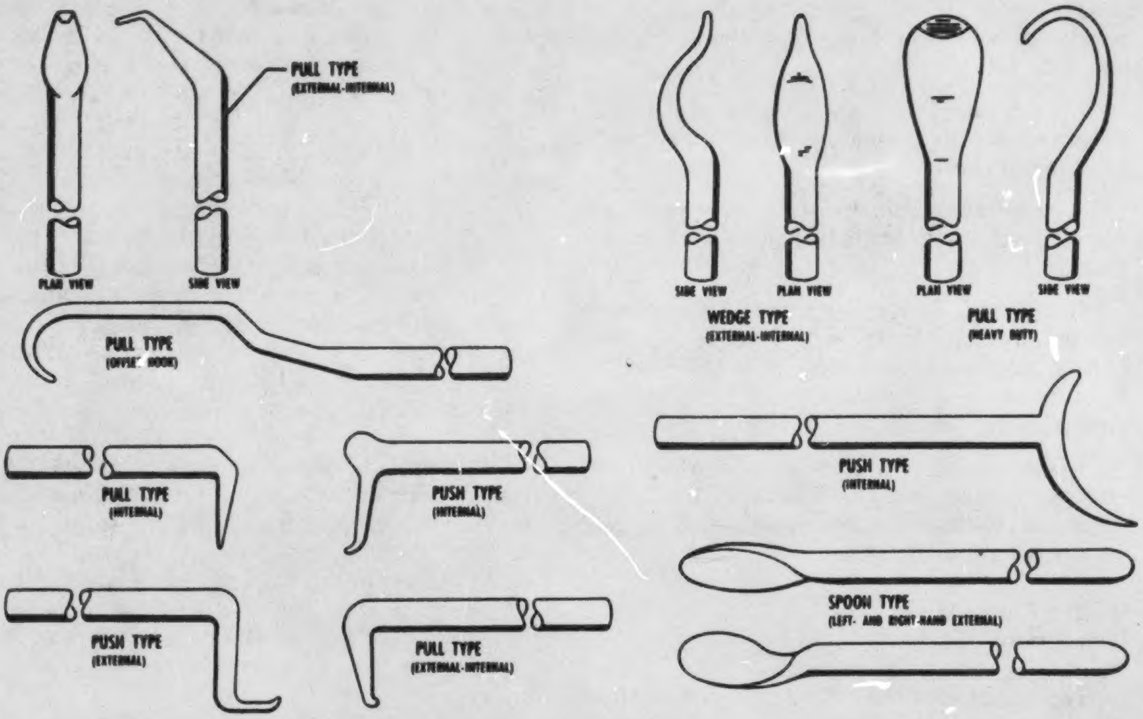
When removing or installing O-rings, avoid using pointed or sharp-edged tools which might cause scratching or marring of hydraulic component surfaces or cause damage to the O-rings. While using the seal removal and installation tools, contact with cylinder walls, piston heads, and related precision components is not desirable. With practice, the AS should become proficient in using these tools.

Notice in figure 8-4, view (A), how the hook-type removal tool is positioned under the O-ring and then lifted to allow the extractor tools, as well as the removal tools, to pull the O-ring from its cavity. View (B) shows the use of another type of extractor tool in the removal of internally installed O-rings.

In view (C), notice the extractor tool positioned under both O-rings at the same time. This method of manipulating the tool, positions both O-rings, allowing the hook-type removal tool to extract both O-rings with minimum effort. View (D) shows practically the same removal as view (C), except for the use of a different type of extractor tool.

The removal of external O-rings is less difficult than the removal of internally installed O-rings. Views (E) and (F) illustrate two accepted removal methods. View (E) shows the use of a spoon-type extractor, which is positioned under the seal. After the O-ring is dislodged from its cavity, the spoon is held stationary while simultaneously rotating and withdrawing the piston. View (F) installation is similar to view (E), except only one O-ring is installed, and a different type of extractor tool is used. The wedge-type extractor tool is inserted beneath the O-ring; the hook-type removal tool hooks the O-ring. A slight pull on the latter tool removes the O-ring from its cavity.

After removing all O-rings, cleaning the affected parts receiving new O-rings is mandatory. Ensure that the area used for such installations is clean and free from all contamination. Each O-ring to be replaced should be removed from its sealed package and inspected for defects such as blemishes, abrasions, cuts, or punctures. Although an O-ring may


PULL TYPE
(EXTERNAL-INTERNAL)
PLAN VIEW
SIDE VIEW
SIDE VIEW
PLAN VIEW
PLAN VIEW
SIDE VIEW
WEDGE TYPE
(EXTERNAL-INTERNAL)
PULL TYPE
(HEAVY DUTY)
PULL TYPE
(OFFSET HOOK)
PULL TYPE
(INTERNAL)
PUSH TYPE
(INTERNAL)
PUSH TYPE
(INTERNAL)
SPOON TYPE
(LEFT- AND RIGHT-HAND EXTERNAL)
PUSH TYPE
(EXTERNAL)
PULL TYPE
(EXTERNAL-INTERNAL)

215.12

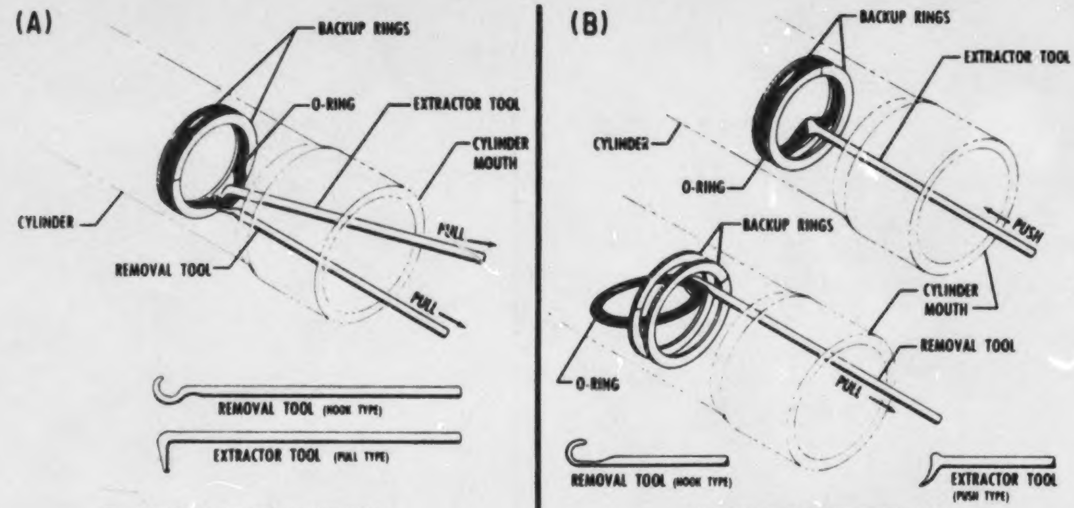
Figure 8-3.—Typical O-ring installation and removal tools.

appear perfect at first glance, slight surface flaws may exist. These are often capable of preventing satisfactory O-ring performance under the variable operating pressures of hydraulic systems. O-rings should be rejected for flaws that will affect their performance.

By rolling the ring on an inspection cone or dowel, the inner diameter surface can also be checked for small cracks, particles of foreign matter, and other irregularities that would cause leakage or shorten the life of O-rings. The slight stretching of the ring when it is rolled inside out will help to reveal some defects not otherwise visible.

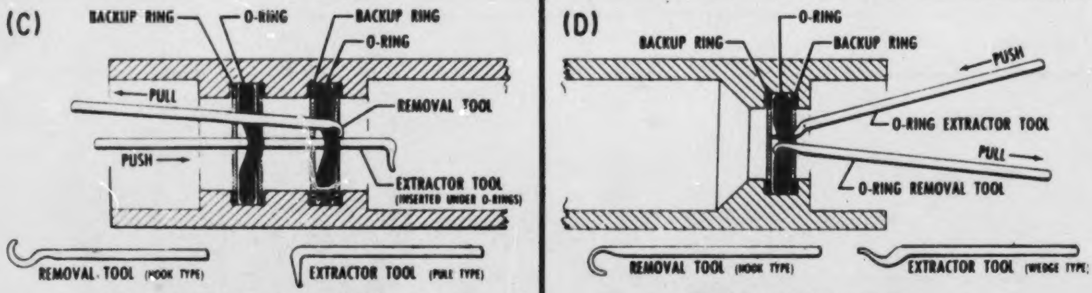
A further check of each O-ring should be made by stretching it between the fingers, but care must be taken not to exceed the elastic limits of the rubber. Following these inspection procedures will prove to be a maintenance economy. It is far more desirable to take care when identifying and inspecting O-rings than to repeatedly repair components because of faulty seals.

After inspection and prior to installation, immerse the O-ring in clean hydraulic fluid of the type which is compatible with the seal. During the installation, avoid rolling and twisting the O-ring to maneuver it into place. If possible, keep the position of the O-ring's mold line constant. When the O-ring installation requires spanning or inserting through sharp threaded areas, ridges, slots, and edges, use protective measures, such as O-ring entering sleeves as shown in (A) of figure 8-5. If the recommended O-ring entering sleeve (soft thin-wall metallic sleeve) is not available, paper sleeves and covers may be fabricated by using the seal


(A)
BACKUP RINGS
O-RING
EXTRACTOR TOOL
CYLINDER MOUTH
CYLINDER
PULL
REMOVAL TOOL
PULL
REMOVAL TOOL (HOOK TYPE)
EXTRACTOR TOOL (PULL TYPE)
(B)
BACKUP RINGS
EXTRACTOR TOOL
CYLINDER
O-RING
PUSH
BACKUP RINGS
CYLINDER MOUTH
REMOVAL TOOL
O-RING
PULL
REMOVAL TOOL (HOOK TYPE)
EXTRACTOR TOOL (PUSH TYPE)

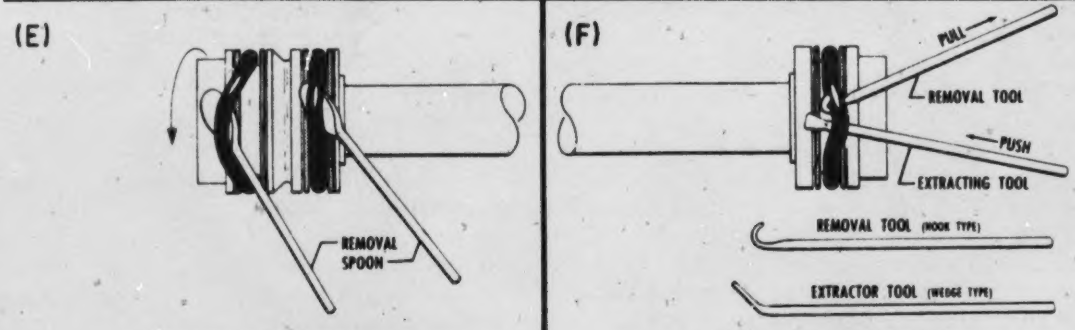
INTERNAL O-RING REMOVAL
(USING PULL TYPE EXTRACTOR AND HOOK TYPE REMOVAL TOOLS)

INTERNAL O-RING REMOVAL
(USING PUSH TYPE EXTRACTOR AND HOOK TYPE REMOVAL TOOLS)


(C)
BACKUP RING
O-RING
BACKUP RING
O-RING
PULL
REMOVAL TOOL
PUSH
EXTRACTOR TOOL (INSERTED UNDER O-RINGS)
REMOVAL TOOL (HOOK TYPE)
EXTRACTOR TOOL (PULL TYPE)
(D)
O-RING
BACKUP RING
BACKUP RING
PUSH
O-RING EXTRACTOR TOOL
PULL
O-RING REMOVAL TOOL
REMOVAL TOOL (HOOK TYPE)
EXTRACTOR TOOL (WEDGE TYPE)

DUAL INTERNAL O-RING REMOVAL
(USING PUSH TYPE EXTRACTOR AND HOOK TYPE REMOVAL TOOLS)

INTERNAL O-RING REMOVAL
(USING WEDGE TYPE EXTRACTOR AND HOOK TYPE REMOVAL TOOLS)


(E)
REMOVAL SPOON
(F)
PULL
REMOVAL TOOL
PUSH
EXTRACTING TOOL
REMOVAL TOOL (HOOK TYPE)
EXTRACTOR TOOL (WEDGE TYPE)

EXTERNAL O-RING REMOVAL
(USING SPOON TYPE EXTRACTOR REMOVAL TOOLS)

EXTERNAL O-RING REMOVAL
(USING WEDGE TYPE EXTRACTOR AND HOOK TYPE REMOVAL TOOLS)

215.13

Figure 8-4.—O-ring removal.

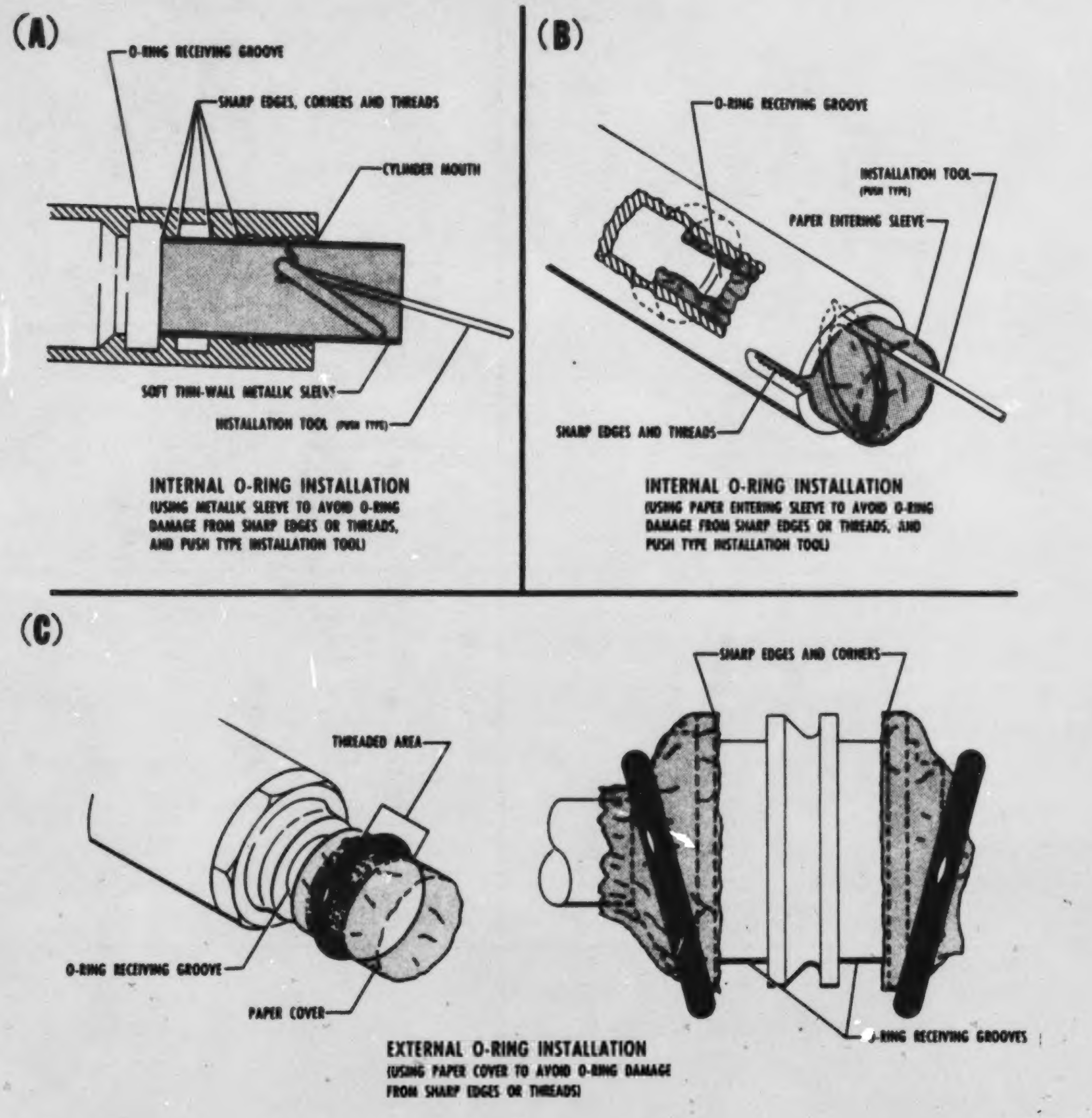

(A)
O-RING RECEIVING GROOVE
SHARP EDGES, CORNERS AND THREADS
CYLINDER MOUTH
SOFT THIN-WALL METALLIC SLEEVE
INSTALLATION TOOL (PUSH TYPE)
INTERNAL O-RING INSTALLATION
(USING METALLIC SLEEVE TO AVOID O-RING DAMAGE FROM SHARP EDGES OR THREADS, AND PUSH TYPE INSTALLATION TOOL)
(B)
O-RING RECEIVING GROOVE
INSTALLATION TOOL (PUSH TYPE)
PAPER ENTERING SLEEVE
SHARP EDGES AND THREADS
INTERNAL O-RING INSTALLATION
(USING PAPER ENTERING SLEEVE TO AVOID O-RING DAMAGE FROM SHARP EDGES OR THREADS, AND PUSH TYPE INSTALLATION TOOL)
(C)
SHARP EDGES AND CORNERS
THREADED AREA
O-RING RECEIVING GROOVE
PAPER COVER
O-RING RECEIVING GROOVES
EXTERNAL O-RING INSTALLATION
(USING PAPER COVER TO AVOID O-RING DAMAGE FROM SHARP EDGES OR THREADS)
215.14

Figure 8-5.—O-ring installation.

package (gloss side out) or lint-free bond paper. (See (B) and (C) of figure 8-5.)

Adhesive tapes should not be used to cover danger areas on components. Gummy substances left by the adhesives are extremely detrimental to hydraulic systems.

After the O-ring is placed in the cavity provided, gently roll the O-ring with the fingers to remove any twist that might have occurred during installation.

BACKUP RINGS

Backup rings are used to support O-rings and to prevent O-ring deformation and resultant leakage. Two types of backup rings are used in support equipment—Teflon (single and double spiral) and chrome-retanned leather. Teflon backup rings are generally used with both packings and gaskets; however, leather backup rings may be used with gasket type seals in systems operating up to 1,500 psi.

Teflon rings are made from a fluorcarbon-resin material which is tough, friction-resistant, and more durable than leather. Precautions similar to those applicable to O-rings must be taken to avert contamination of backup rings and damage to hydraulic components.

Teflon backup rings may be stocked in individual sealed packages similar to those in which O-rings are packed, or several may be installed on a cardboard mandrel.

If unpackaged rings are stored for a long period of time without the use of mandrels, a condition of overlap may develop. In order to eliminate this condition, stack the Teflon rings on a mandrel of a diameter comparable to the desired diameter of the spiral ring. Stack and clamp the rings with their coils flat and parallel. Then place the rings in an oven at a maximum temperature of 350°F for a period of approximately 10 minutes. The rings are then removed and water quenched. NOTE: After this treatment, rings should be stored at room temperature for a period of 48 hours prior to use.

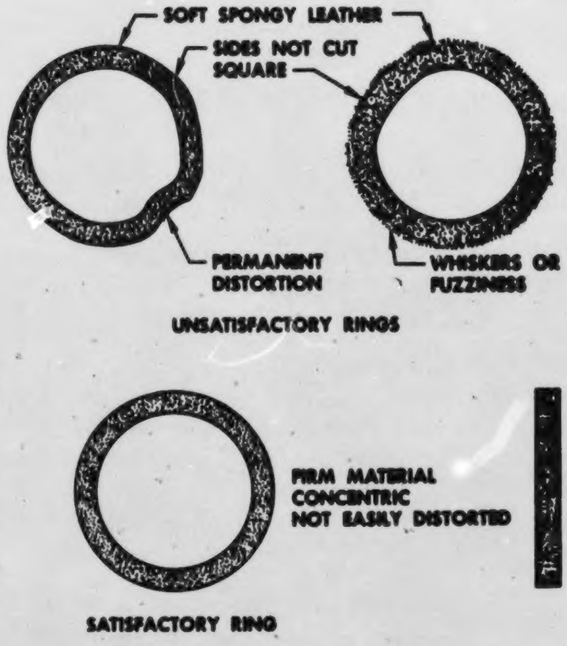
Identification

Backup rings are not color coded or otherwise marked and must be identified from package labels.

Backup rings made from Teflon do not deteriorate with age, are unaffected by any fluid or vapor, and tolerate temperature extremes in excess of those encountered in high-pressure hydraulic systems. The dash number, which is found on the package, following the specification number, indicates the size and, in some cases, relates directly to the dash number of the O-ring for which the backup ring is dimensionally suited. For example, the single spiral Teflon ring, MS28774-6, is used with MS28775-006 O-ring; and the double spiral Teflon ring, MS28782-1, is used with the AN6227B-1 O-ring.

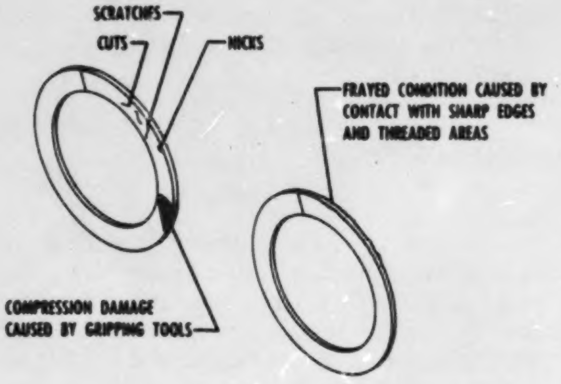
Installation

Care must be taken during the handling and installation of backup rings. If possible, backup rings should be inserted by hand and without the use of sharp tools. Leather backup rings must first be soaked in the recommended fluid to increase their flexibility for ease of installation. For reuse of leather backup rings, they must be inspected to meet the requirements, as shown in figure 8-6. The Teflon backup rings must also be inspected prior to reuse for evidence of compression damage, scratches, cuts, nicks, and fraying conditions, as illustrated in figure 8-7.



315.15

Figure 8-6.—Leather backup rings— satisfactory and unsatisfactory condition.


SCRATCHES
CUTS
NICKS
FRAYED CONDITION CAUSED BY CONTACT WITH SHARP EDGES AND THREADED AREAS
COMPRESSION DAMAGE CAUSED BY GRIPPING TOOLS

215.16

Figure 8-7.—Teflon backup rings—damages caused by improper handling.

To install the leather type backup ring (figure 8-8), the following steps should be used:

1. Soak new backup ring in clean hydraulic fluid until it is pliable.
2. Immerse the new gasket in the same type of hydraulic fluid as used in the hydraulic system.
3. Examine the fitting groove for roughness that might damage the seal.
4. Position the jamnut well above the fitting groove, and coat the male threads of the fitting sparingly with hydraulic fluid.
5. Install the backup ring in the fitting groove with the smooth side away from the jamnut, and work the backup ring into the counterbore of the jamnut.
6. Install the gasket in the fitting groove against the backup ring.
7. The jamnut is then turned down until the gasket is pushed firmly against the threaded portion of the fitting.
8. Install the fitting into the boss, and turn until the gasket has contacted the boss. (The jamnut must turn with the fitting.)
9. While holding the jamnut from turning, turn the fitting 1 1/2 additional turns.
10. The fitting is then positioned by turning it not more than one turn.
11. Hold the fitting in the desired position, and turn the nut down tight against the boss.

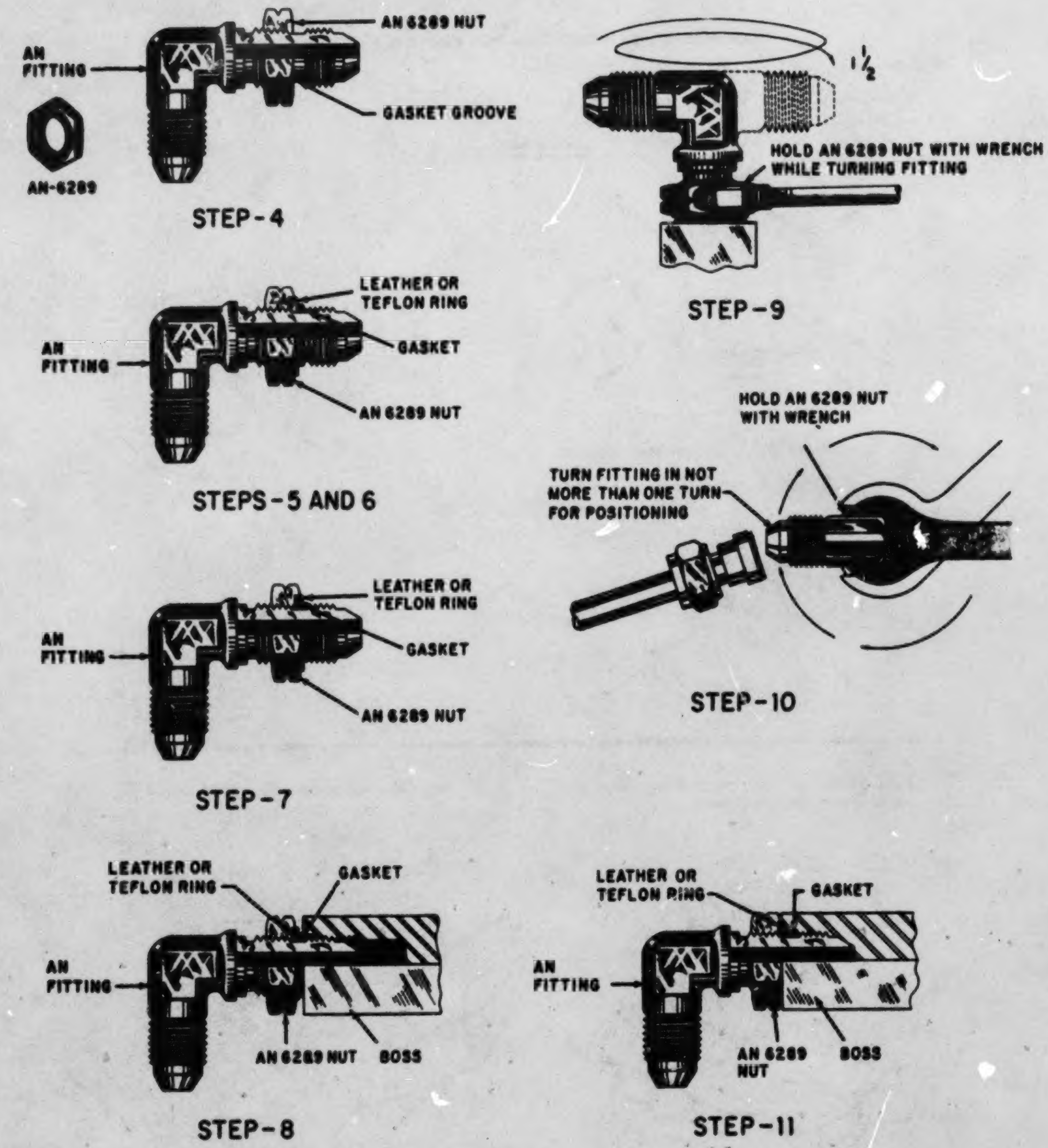
When Teflon spiral rings are being installed in internal grooves, the ring must have a right-hand spiral. Figure 8-9, view (A), shows the method used to change directions of the spiral. The Teflon ring is then stretched slightly, as shown in view (B), prior to installation into its groove. While the Teflon ring is being inserted in the groove, rotate the component in a clockwise direction. This action will tend to expand the ring diameter and reduce the possibility of damage to the ring.

When Teflon spiral rings are being installed in external grooves, the ring should have a left-hand spiral. As the ring is inserted into the groove, rotate the component in a clockwise direction. This action will tend to contract the ring diameter and reduce the possibility of damage to the ring.

Backup rings may be installed singly, if pressure acts only upon one side of the seal. In this case, the backup ring is installed next to the O-ring, opposite the pressure force. (See view (A) in figure 8-10.) When dual backup rings are installed, the split scarfed ends must be staggered as shown in view (B). View (C) shows an improper dual ring installation.

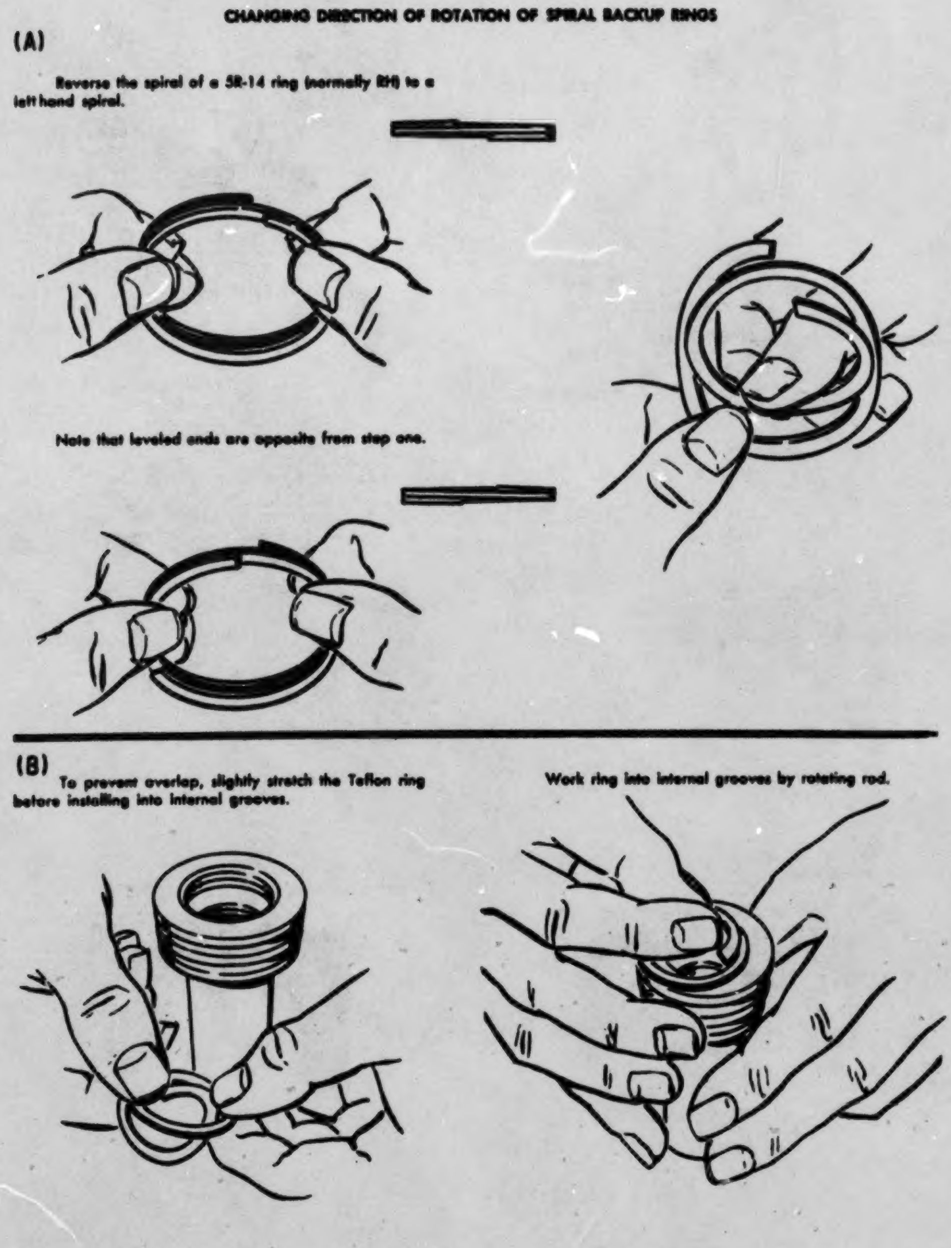
WIPERS

Wipers (scrapers) are used to clean and lubricate the exposed portion of piston shafts. This prevents foreign matter from entering the system and scoring internal surfaces. They are used in most actuating cylinders. Wipers may be of the metallic (usually copper base alloys) or felt types. In some cases, they are used together, the felt wiper being installed behind the metallic wiper. Normally, the felt wiper is lubricated with system hydraulic fluid from a drilled bleed passage or from an external fitting.


AN FITTING
AN 6289 NUT
GASKET GROOVE
AN-6289
STEP-4
1½
HOLD AN 6289 NUT WITH WRENCH WHILE TURNING FITTING
STEP-9
LEATHER OR TEFLON RING
GASKET
AN FITTING
AN 6289 NUT
STEPS-5 AND 6
HOLD AN 6289 NUT WITH WRENCH
TURN FITTING IN NOT MORE THAN ONE TURN FOR POSITIONING
STEP-10
LEATHER OR TEFLON RING
GASKET
AN FITTING
AN 6289 NUT
STEP-7
LEATHER OR TEFLON RING
GASKET
AN FITTING
AN 6289 NUT
BOSS
STEP-8
LEATHER OR TEFLON RING
GASKET
AN FITTING
AN 6289 NUT
BOSS
STEP-11

215.17

Figure 8-8.—Properly installed gasket and backup ring.



CHANGING DIRECTION OF ROTATION OF SPIRAL BACKUP RINGS

(A)

Reverse the spiral of a 5R-14 ring (normally RH) to a left hand spiral.

Note that leveled ends are opposite from step one.

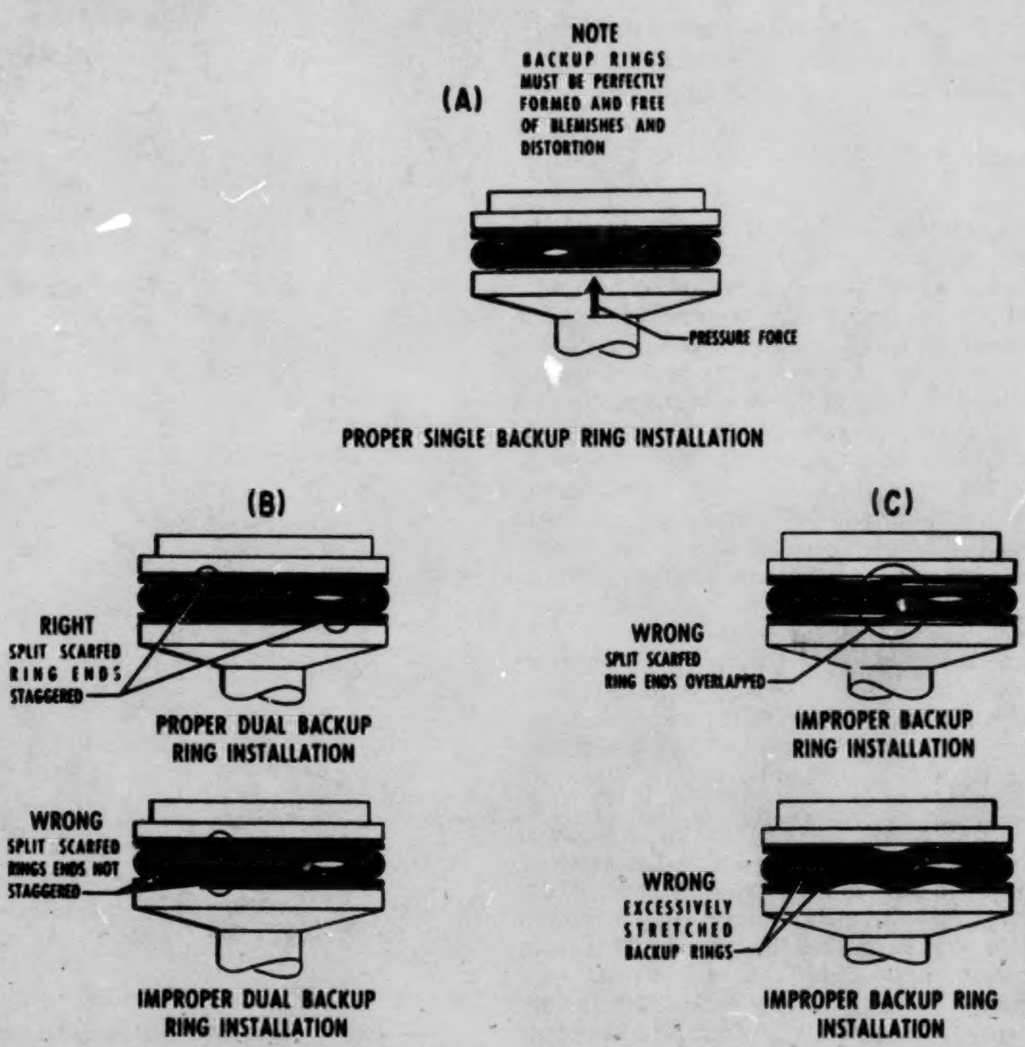
(B)

To prevent overlap, slightly stretch the Teflon ring before installing into internal grooves.

Work ring into internal grooves by rotating rod.

215.18

Figure 8-9.—Installation of Teflon backup rings (internal).


NOTE
BACKUP RINGS MUST BE PERFECTLY FORMED AND FREE OF BLEMISHES AND DISTORTION
(A)
PRESSURE FORCE
PROPER SINGLE BACKUP RING INSTALLATION
(B)
RIGHT
SPLIT SCARFED RING ENDS STAGGERED
PROPER DUAL BACKUP RING INSTALLATION
WRONG
SPLIT SCARFED RINGS ENDS NOT STAGGERED
IMPROPER DUAL BACKUP RING INSTALLATION
(C)
WRONG
SPLIT SCARFED RING ENDS OVERLAPPED
IMPROPER BACKUP RING INSTALLATION
WRONG
EXCESSIVELY STRETCHED BACKUP RINGS
IMPROPER BACKUP RING INSTALLATION

215.19

Figure 8-10.—Teflon backup ring installation (external).

Wipers are manufactured for a specific hydraulic component and must be ordered for that application. Wipers are normally inspected and changed, if necessary, while component repair is in process.

Metallic wipers are formed in split rings for ease in installation and are manufactured slightly undersize to insure a tight fit. One side of the metallic wiper has a lip which should face outward upon installation. Metallic wipers are inspected for foreign matter and condition and then installed by sliding over the piston shaft in the proper order, as directed by the applicable Instructions Manual.

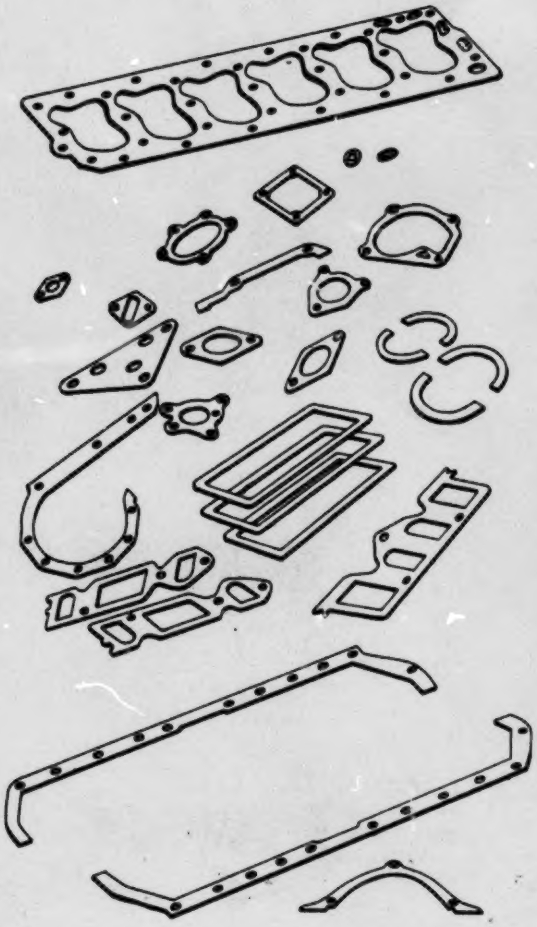
The felt wiper may be a continuous felt ring or a length of felt with sufficient material to overlap its ends. The felt wiper should be soft, clean, and well saturated in hydraulic fluid during installation.

GASKETS

Gaskets are used as static or stationary seals. Their principal use in a fluid system is around end caps of cylinders, valves, and other units. Gaskets must not be compressed against irregular or rough surfaces that could cut or damage them. To do so can destroy the sealing quality of the gasket. Since it is not possible to have the matching surfaces of the cylinder block and cylinder head of an engine smooth enough to make a gastight fit, a gasket is used that is able to withstand the pressure and heat developed by the cylinders. The gaskets (figure 8-11) that serve as seals between engine parts in assembly require as much attention during assembly as any other part. It is impractical to machine all surfaces so that they fit together to form a perfect seal. The gaskets make a joint that is air, water, or oil tight; therefore, when properly installed, they prevent loss of compression, coolant, or lubricant.

The CYLINDER HEAD GASKET is placed between the cylinder head and engine block to maintain a gas- and coolant-tight seal. These gaskets may be metal sheets soft enough to deform as required, but they are usually made in the form of two thin plates of soft metal with asbestos filling between them. Holes are punched in the gasket to conform with the openings in the head and block, which allows the cooling water to circulate. If a poorly made or improper gasket is used, the flow of cooling water may be restricted, causing troublesome hot spots.

On some engines, especially V-type, the gaskets are so nearly uniform that they can be turned upside down or end for end and still fit the retaining studs and combustion chambers. If they are improperly installed, however, they will stop water circulation at some parts of the engine. It is important to make sure that the correct gasket is used and that it is correctly installed.



81.52

Figure 8-11.—Engine overhaul gasket kit.

The INTAKE AND EXHAUST MANIFOLD GASKETS are usually made from asbestos formed to the desired shape. Some of them are metal covered asbestos similar in construction to head gaskets. Because of the heat of the exhaust and intake air, it is necessary that manifold gaskets be made from a material that will not burn.

The OIL PAN GASKET is generally made from pressed cork. It may be made in one piece but more often it is made in two pieces: one piece for each side of the pan. Each end of the pan is sealed with cork or neoprene gasket material.

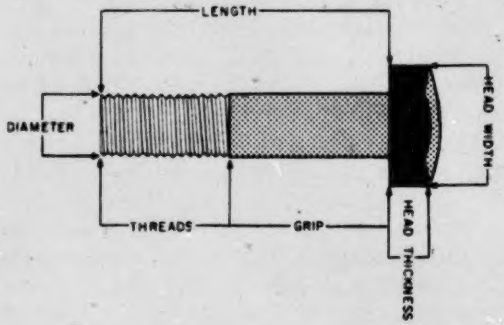
The other gaskets for an engine are usually cut from pressed paper that is oil resistant. The thickness of the paper varies in accordance with manufacturer's recommendations. Often the gaskets used will create specified clearances between moving parts of an engine.

When installing any gasket in an engine, it is important that the surfaces to be sealed are clean and free from grit and parts of the old gasket. A putty knife is useful for cleaning gasket surfaces. You must be sure the gasket is in the proper position and does not slip when the two parts are brought together. Heavy grease or a gasket compound will help you make sure the gaskets stay in place and form a good seal.

The AS should refer to *Fluid Power*, NAVPERS 16193 (Series) and the latest applicable maintenance manual for further references to seals and gaskets.

BOLTS

Many types of bolts are used on support equipment, and each type is used to fasten something in place. However, before discussing some of these types, it might be helpful at this point to list and explain some commonly used bolt terms. The AS should know the names of bolt parts. He should also be aware of the bolt dimensions that must be considered in selecting a bolt. Figure 8-12 illustrates both types of information.



217.65

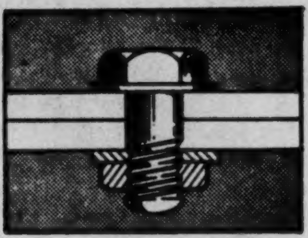
Figure 8-12.—Bolt terms and dimensions.

The three principal parts of a bolt are the HEAD, THREAD, and GRIP. It is possible that two of these parts are well known, but perhaps the "grip" is an unfamiliar term. If so, notice that the grip is the unthreaded part of the bolt shaft and that it extends from the threads to the bolthead. The head is the largest diameter of the bolt and may be one of many shapes or designs. The head retains the bolt in place in one direction, and the nut used on the threads retains it in the other direction.

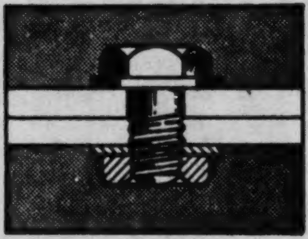
In order to choose the correct replacement for an unserviceable bolt, several bolt dimensions must be considered, one being the length of the bolt. As shown in figure 8-12, the bolt length is the distance from the tip of the threaded end to the head of the bolt. Correct length selection is indicated when the chosen bolt extends through the nut at least 1/32 inch in the case of flat-end bolts (figure 8-12) or in the case of chamfered (rounded) end bolts, at least one full chamfer should extend through the nut. If the bolt is too short, it may not extend out of the bolthole far enough for the nut to be securely fastened. If it is too long, it may extend so far that it interferes with the movement of nearby parts. Unnecessarily long bolts, especially in numbers, can affect weight and balance and reduce the payload capacity.

In addition, if a bolt is too long or too short, its grip will usually be the wrong length. As shown in figure 8-13, grip length should be approximately the same as the thickness of the material to be fastened. If the grip is too short, the threads of the bolt will extend into the bolthole and may act like a reamer when the material is vibrating. To prevent this, make certain that no more than two threads extend into the bolthole. Also make certain that any threads that enter the bolthole extend only into the thicker member that is being fastened. If the grip is too long, the nut will run out of threads before it can be tightened. In this event a bolt with a shorter grip should be used, or if the bolt grip extends only a short distance through the hole, a washer may be used.

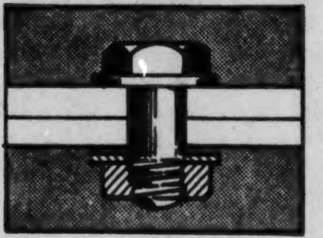
A second bolt dimension that must be considered is diameter. As shown in figure 8-12, the



BOLT GRIP LENGTH CORRECT



BOLT GRIP LENGTH TOO SHORT



BOLT GRIP LENGTH TOO LONG

29.124

Figure 8-13.—Correct and incorrect grip lengths.

diameter of the bolt is the thickness of its shaft. If this thickness is 1/4 inch or more, the bolt diameter is usually given in such fractions of an inch as 1/4, 5/16, 7/16, 1/2, and the like. However, if the bolt is less than 1/4 inch thick, the diameter is usually expressed as a whole number. For instance, a bolt that is 0.190 inch in diameter is called a No. 10 bolt, while a bolt that is 0.164 inch in diameter is called a No. 8.

The results of using a wrong-diameter bolt should be obvious. If the bolt is too big, it cannot of course enter the bolthole. If the diameter is too small, the bolt has too much play in the bolthole, and the chances are that it is not as strong as the correct size of bolt.

The third and fourth bolt dimensions that should be considered when choosing a bolt replacement are head thickness and width. If the head is too thin or too narrow, it may not be strong enough to bear the load imposed on it. If the head is too thick or too wide, it may extend so far that it interferes with the movement of adjacent equipment components.

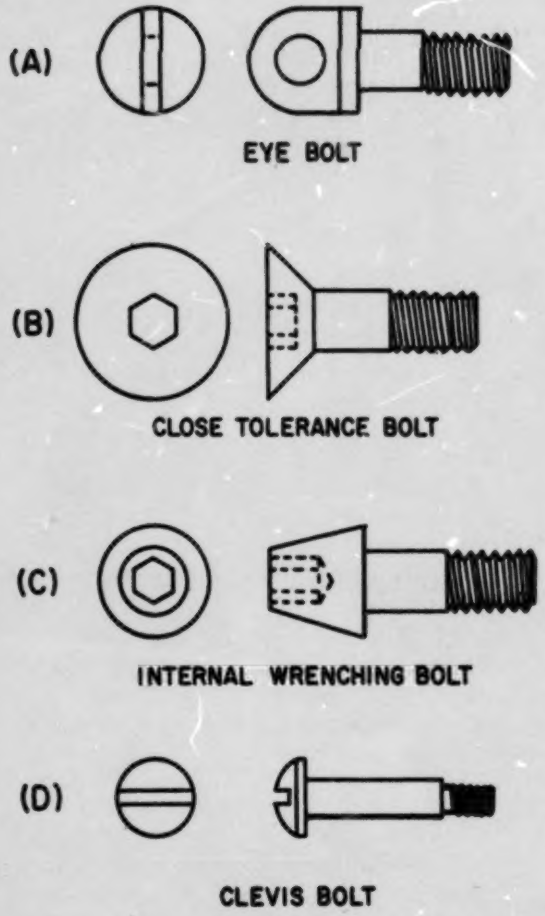
Boltheads

The most common type of head is the hex head, shown in figures 8-12 and 8-13. This type of head may be thick for greater strength or relatively thin in order to fit in places having limited clearances. In addition, the head may be common or drilled. A hex head bolt may have a single hole drilled through it between two of the sides of the hexagon and still be classed as a common. The drilled head hex bolt has three holes drilled in the head, connecting opposite sides of the hex.

Four additional types of boltheads are shown in figure 8-14. Notice that panel A shows an eyebolt, often used in mechanical control systems. Panel B shows a countersunk head, close tolerance bolt. Panel C shows an internal wrenching bolt. Both the countersunk head bolt and the internal wrenching bolts have hexagonal recesses (six-sided holes) in their heads. They are tightened and loosened by use of appropriate size Allen wrenches. Panel D shows a clevis bolt with its characteristic round head. This head may be slotted, as shown, to receive a common screwdriver or recessed to receive a Reed and Prince or a Phillips screwdriver.

Bolt Threads

Another structural feature in which bolts may differ is threads. These usually come in one of the two types—coarse or fine, and the two are not interchangeable. For any given size of bolt there are a different number of coarse and fine threads per inch. For instance, consider the 1/4-inch bolts. Some are called 1/4-28 bolts, because they have 28 fine threads per inch.



217.67

Figure 8-14.—Boltheads.

Others have only 20 coarse threads per inch and are called 1/4-20 bolts. To force one size of threads into another size, even though both are 1/4 inch, will strip the finer threads or softer metal. The same thing is true concerning the other sizes of bolts; therefore, make certain that bolts selected have the correct type of threads.

Bolt Material

The type of metal used in a bolt helps to determine its strength and its resistance to corrosion. Therefore, make certain that material is considered in the selection of replacement bolts. Some bolts have distinctive head markings that help to identify the material from which they are manufactured. In certain cases, manufacturers are compelled to make bolts of different dimensions or greater strength than the standard types. Such bolts are made for a particular application, and it is of extreme importance that like bolts are used in replacement. Such special bolts are usually identified by the letter S stamped on the head. Figure 8-15 shows the tops of several hex-bolt heads, each marked to indicate the type of bolt material.

Unless current directives specify otherwise, every unserviceable bolt should be replaced with a bolt of the same type. Of course, substitute and interchangeable items are sometimes available, but the ideal fix is a bolt-for-bolt replacement. The part number of a needed bolt may be obtained by referring to the Illustrated Parts Breakdown (IPB) for the equipment concerned.

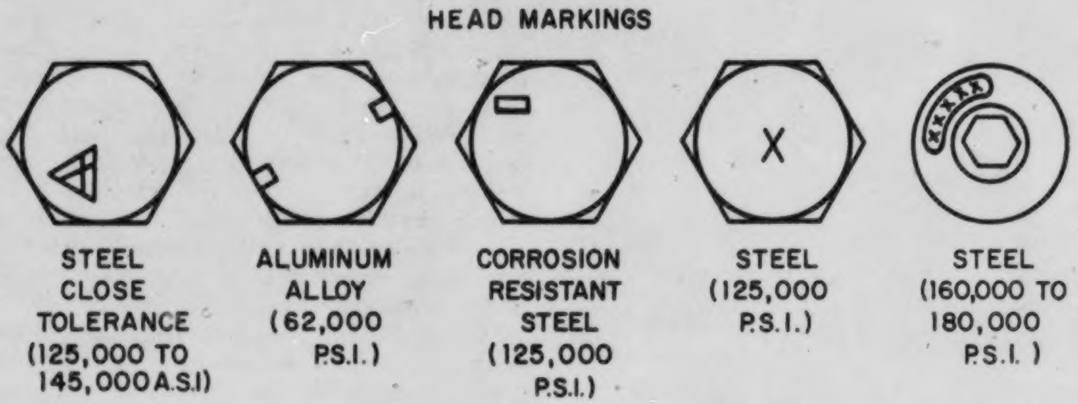
Safety Wire

Safety wire is available in many different types and sizes. One must first select the correct type and size wire for the particular job. Many of the nuts, except the self-locking types, and boltheads on support equipment must be safetied, the method used depending upon the particular installation. Figure 8-16 illustrates the correct methods of installing safety wire. The following general rules apply to safety wiring:

1. All safety wire must be tight after installation, but not under so much tension that normal handling or vibration will break the wire.

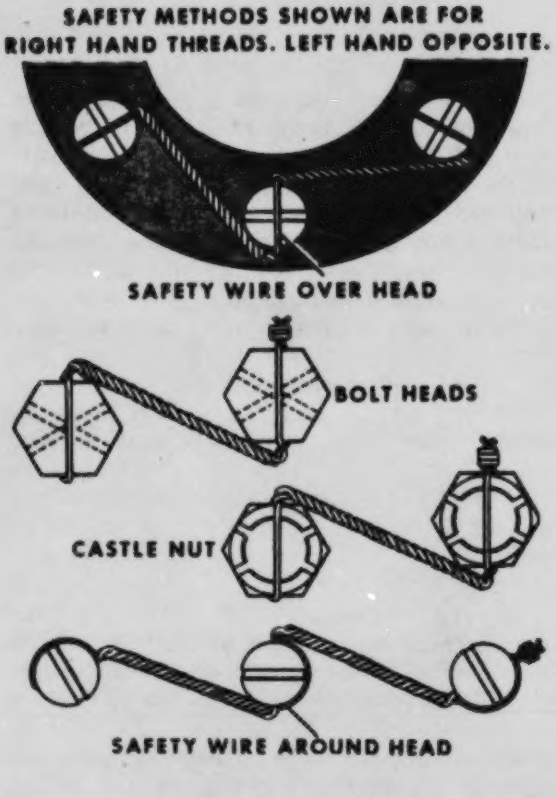
2. The wire must be applied so that all pull exerted by the wire tends to tighten the nut or bolt.

3. Twists should be tight and even and the wire between nuts as taut as possible without overtwisting. Wire-twister pliers should be used if available; otherwise, wire between nuts should be twisted with the hands. The use of regular pliers will damage the wire. Regular pliers may be used only for final end twist prior to cutting off the excess wire.


HEAD MARKINGS
STEEL CLOSE TOLERANCE (125,000 TO 145,000A.S.I)
ALUMINUM ALLOY (62,000 P.S.I.)
CORROSION RESISTANT STEEL (125,000 P.S.I.)
STEEL (125,000 P.S.I.)
STEEL (160,000 TO 180,000 P.S.I.)

217.68

Figure 8-15.—Bolthead markings.


SAFETY METHODS SHOWN ARE FOR RIGHT HAND THREADS. LEFT HAND OPPOSITE.
SAFETY WIRE OVER HEAD
BOLT HEADS
CASTLE NUT
SAFETY WIRE AROUND HEAD

217.81

Figure 8-16.—Safety wire installations.

MISCELLANEOUS HARDWARE

The AS should become familiar with other miscellaneous hardware for ground support equipment. He should be aware of their purposes in performing the proper maintenance on ground support equipment.

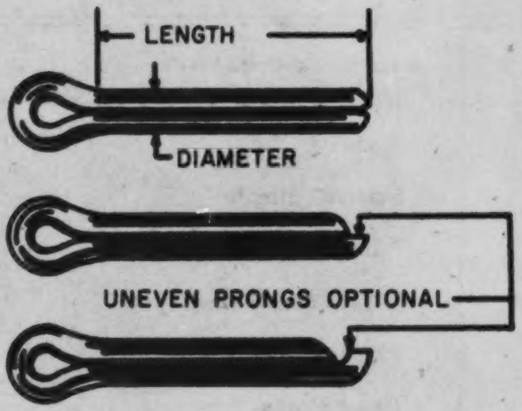
COTTER PINS

Cotter pins are used to secure bolts, screws, nuts, and pins. Some cotter pins are made of low-carbon steel, while others consist of stainless steel and thus are more resistant to corrosion. In addition, stainless steel cotter pins may be used in locations where nonmagnetic material is required. Regardless of shape or material, all cotter pins are used for the same general purpose—safetying. Figure 8-17 shows three types of cotter pins and how their size is determined.

NOTE: Whenever uneven prong cotter pins are used, the length measurement is to the end of the shortest prong.

RIVETS

Flathead rivets. Flathead rivets, like roundhead rivets, are used in the assembly of structures where maximum strength is required, but



44.65A

Figure 8-17.—Types of cotter pins.

where interference of nearby members does not permit the use of round head rivets.

Countersunk-head rivets. Countersunk-head rivets, often referred to as FLUSH RIVETS, are used where streamlining is important. For example, practically all external surfaces of pod enclosures for gas turbine power units are flush riveted. Countersunk-head rivets are obtainable with heads having an included angle of 78 and 100 degrees. The 100-degree is the most commonly used type.

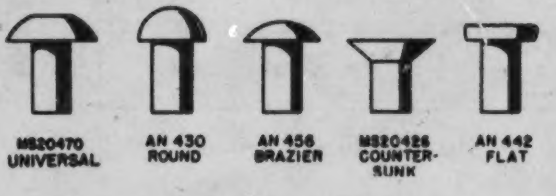
Brazier-head rivets. Brazier-head rivets are frequently used on external surfaces of support equipment.

Universal-head rivets. Universal-head rivets are similar to brazier-head rivets and are to be used in place of other protruding head rivets when existing stocks are depleted.

Rivets are also available in various other head types. These include the cone head, round top countersunk head, button head, truss head, and pan head.

Rivet Identification Code

The rivet codes as shown in figure 8-18 are sufficient to identify rivets only as to head



226.17

Figure 8-18.—Rivet head shapes and code numbers.

shape. To be meaningful and to precisely identify a rivet, certain other information is encoded and added to the basic code.

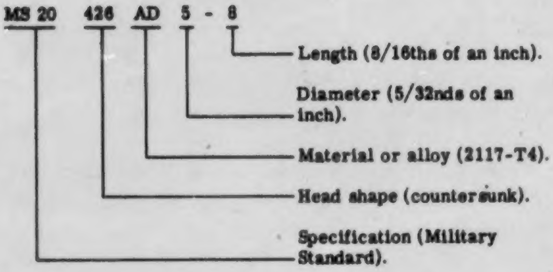
A letter or letters following the head-shape code identifies the material or alloy from which the rivet was made. (Figure 8-19 includes a list of the most common of these codes.) The material code is followed by two numbers separated by a dash. The first number is the numerator of a fraction which specifies the shank diameter in thirty-seconds of an inch. The second number is the numerator of a fraction in sixteenths of an inch and identifies the length of the rivet. The rivet code is illustrated in figure 8-20.

Every AS should have some knowledge of how to use rivets. Many of the sheet metal seams on support equipment are joined together with some type of rivet. Rivets are also used for fastening innumerable bracing members and other parts together. Due to the different types of metals and strength requirements of the various types of support equipment, several different types of rivets are required. Rivets that are satisfactory for one area of an item of equipment are often unsatisfactory for another area of the same equipment. It is therefore important that the AS know the strength and driving properties of the various types of rivets and how to identify them as well as how to drive or otherwise install them. Some of the various rivets used in ground support equipment are described in the following paragraphs.

Rivets are available in many different materials, sizes, and types. Rivets made of steel, copper, brass, and aluminum are widely

Material or alloy	Code letters	Head marking on rivet
1100 Aluminum alloy	A	Plain
2117 Aluminum alloy	AD	Indented dimple
2017 Aluminum alloy	D	Raised teat
2024 Aluminum alloy	DD	Raised double dash
5056 Aluminum alloy	B	Raised cross
Corrosion Resistant steel	F	Indented dash
Monel	M	Two raised teats

Figure 8-19.—Rivet material identification.


MS 20
426
AD
5
-
8
Length (8/16ths of an inch).
Diameter (5/32nds of an inch).
Material or alloy (2117-T4).
Head shape (countersunk).
Specification (Military Standard).

217.55

Figure 8-20.—Rivet coding example.

used. In general, rivets should be of the same material as the metal which they join. The two general classifications of rivets used in support equipment are SOLID rivets and BLIND rivets.

SOLID RIVETS.—Solid rivets are classified by their head shape, by the material from which they are manufactured, and by their size. Rivet head shapes and their identification code numbers are shown in figure 8-18. Like the seals described previously, the code numbers of most rivets and, in fact, most hardware are prefixed by the letters MS. The AN rivets shown in the illustration are obsolete for future procurement, but the rivets are allowed to be used until stocks on hand are depleted and replaced with MS rivets.

The various head shapes and their uses are discussed in the following paragraphs.

ROUNDHEAD RIVETS.—Roundhead rivets are used in areas where strength is the major factor and streamlining is not important. The size of the head is such that it covers sufficient area to strengthen the sheet around the hole and at the same time offers considerable resistance to tension.

TINNERS' RIVETS.—Tinners' rivets are often used to fasten some types of sheet metal such as galvanized iron. Tinners' rivets are made from mild steel and have flat heads. These rivets are usually coated with tin or zinc.

Tinners' rivets vary in size from the 8-ounce rivet to the 16-pound rivet. The size designation indicates the weight of 1,000 rivets; thus, if 1,000 rivets weigh 8 ounces, each rivet is called an 8-ounce rivet. As the weight per 1,000 rivets increases, the diameter and length also increase. For example, the 8-ounce rivet has a diameter of

0.089 inch and a length of 5/32 inch, while the 12-pound rivet has a diameter of 0.259 inch and a length of 1/2 inch.

BLIND RIVETS.—There are many places on ground support equipment where access to both sides of a riveted structural part is impossible, or where limited space does not permit the use of a bucking bar. Furthermore, in the attachment of many nonstructural members, the full strength of solid shank rivets is not necessary.

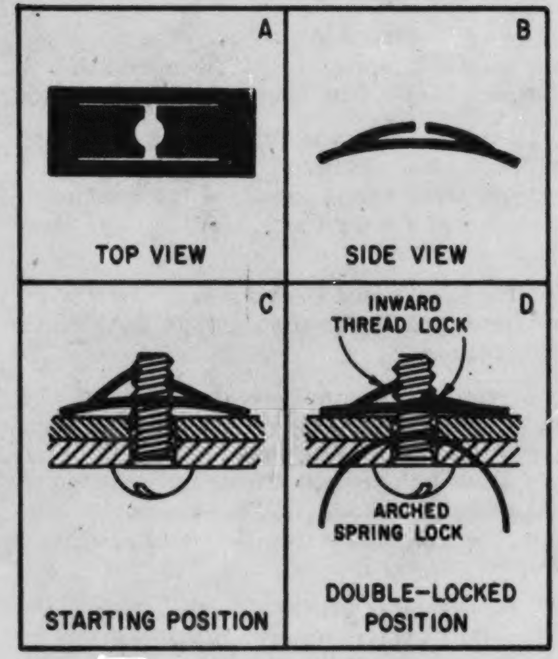
For use in such places, rivets have been designed which can be formed from the outside. They are lighter than solid shank rivets, yet amply strong. These rivets are manufactured by various corporations and have characteristic peculiarities, chief of which is the requirement of special installation tools. Rivets in this category are commonly referred to as blind rivets because of the self-heading feature.

The most common types of blind rivets are the self-plugging (friction lock), the self-plugging (mechanical lock), and the Rivnut. These rivets are adequately described and illustrated in *Airman*, NAVPERS 10307 (Series).

THREADED FASTENERS

Many different types of threaded fasteners are used in the construction of the various types and models of support equipment. Most of these are standard fasteners; however, special fasteners, designed by the manufacturer, are used in the construction of certain types of equipment. Threaded fasteners include bolts, screws, and nuts.

The most common types of threaded fasteners and washers, including installation procedures, are described and illustrated in *Airman*, NAVPERS 10307 (Series). Not included in the Airman Manual is the sheet spring nut which is used on some items of support equipment. This type nut is described in the following paragraph.



217.76

Figure 8-21.—Sheet spring nut.

The sheet spring nut illustrated in figure 8-21 is sometimes used for anchoring lightweight parts in support equipment. Applications include supporting line clamps, electrical equipment, small access doors, etc. It is made of sheet spring steel, cut so as to have two flaps. The ends of these flaps are notched to form a hole that is somewhat smaller in diameter than the screw used. The sheet spring nut has a definite arch which tends to flatten out as the screw pulls the flaps in toward the threads. This flattening action forces the flaps of the nut tightly into the threads of the screw, and the springiness of the sheet spring nut pushes upward on the screw threads, binding them and locking the screw in place. Either a standard or a sheet-metal self-tapping screw is used with this nut.

TURNLOCK FASTENERS

Turnlock fasteners are used to secure inspection plates, doors, and other removable panels on some items of support equipment. Turnlock fasteners are also referred to by such terms as quick-opening and quick-action fasteners. The most desirable feature of these fasteners is that they permit quick and easy removal of access panels for inspection and servicing purposes. Removal and replacement of damaged turnlock fasteners is one of the responsibilities of the AS.

Turnlock fasteners are manufactured and supplied by a number of manufacturers under various trade names. Some of the most commonly used are the Camloc, Airloc, and Dzus (pronounced zoo'-s).

The Camloc and Dzus turnlock fasteners are described and illustrated in *Airman*, NAVPERS 10307 (Series).

Figure 8-22 illustrates the parts that make up an Airloc fastener. As with the Camloc fastener, the Airloc fastener also consists of a receptacle, a stud, and a cross pin. The stud is attached to the access panel and is held in place by the cross pin. The receptacle is riveted to the access panel frame.

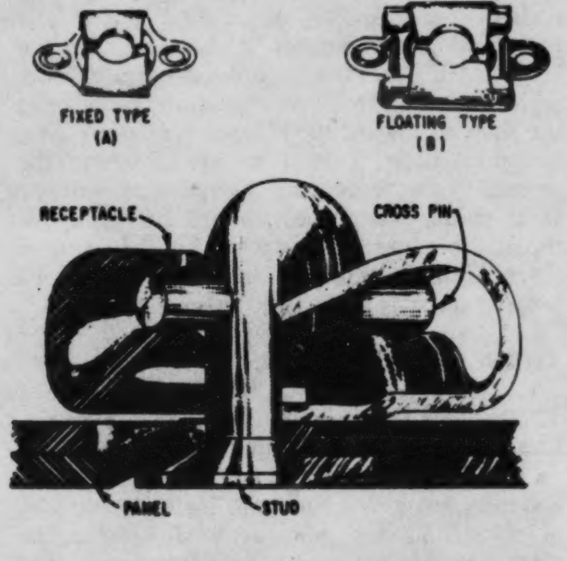
Two types of Airloc receptacles are available—the fixed type (insert A of figure 8-22) and the floating type (insert B of figure 8-22). The floating type makes for easier alignment of the stud in the receptacle. Several types of studs are also available, but in each instance the stud and cross pin come as separate units so that the stud may be easily installed in the access panel.

The size of Airloc fasteners is indicated by a number and is determined by the distance between the centers of the receptacle rivet holes. The Navy usually uses Nos. 2, 5, and 7, which are 3/4 inch, 1 inch, and 1 3/8 inches, respectively. The diameter of the stud shank and the length of the cross pin vary with the different sizes. The stud is available in round, countersunk, or winged head styles.

CLAMPS

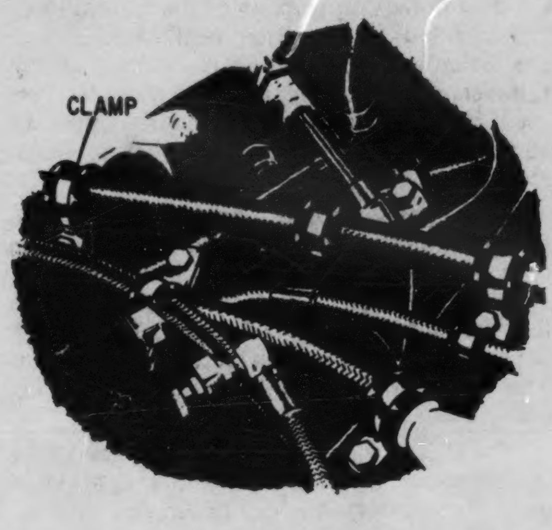
The clamps used on ground support equipment are used to prevent lines from chafing on other parts of the equipment. They are also used to fasten or support other components mounted on the equipment.

Two types of clamps and their uses in supporting flexible and rigid lines can be seen in figure 8-23. These clamps may differ in purpose in that one clamp is designed with a rubber or teflon cushion for low-range temperatures, and the other has an asbestos cushion for high temperatures.



217.63

Figure 8-22.—Airloc fastener.



283.8

Figure 8-23.—Clamps.

Support clamps should be inspected for deterioration of the cushion material to prevent the metal part of the clamps from cutting or chafing the supported lines or hoses. The AS should choose a clamp of the correct size and heat range and ensure that it is in good condition for installation. Figure 8-24 illustrates six ways to secure lines and hoses to each other with support clamps to maintain line clearances and prevent chafing.

FUELS

Petroleum products have always been important to modern military operations. These products are no less important to the AS. This chapter covers petroleum products as related to aviation support equipment.

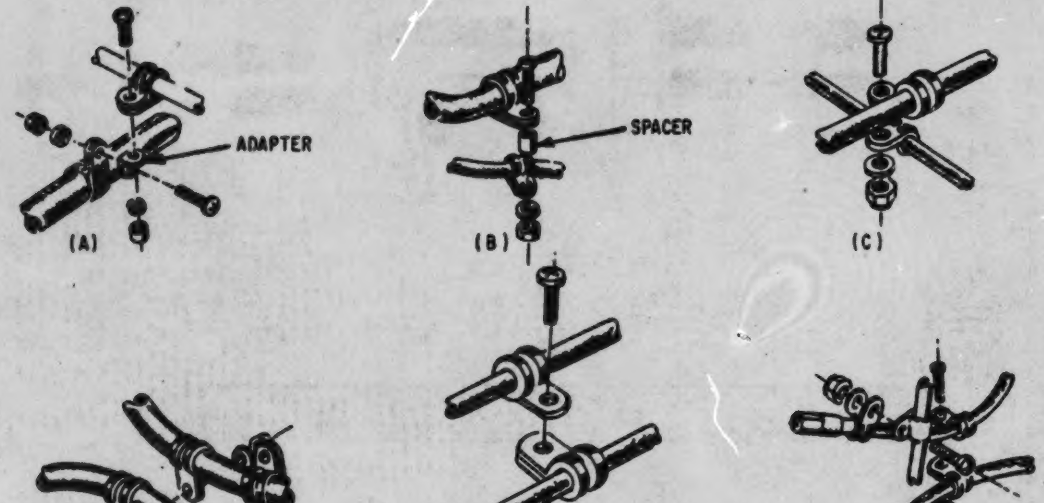
Crude oil is pumped from the earth in all areas of the world. The Middle East is the largest producer of crude oil in the free world. The Western Hemisphere is the second largest producer. North Africa has recently become a large producer of crude oil.

When refined, crude oil furnishes many usable products. Figure 8-25 illustrates the refining process and lists the results. The AS is interested in automotive gasoline, diesel fuel, lubricating oil and grease, and hydraulic fluids.

GASOLINE

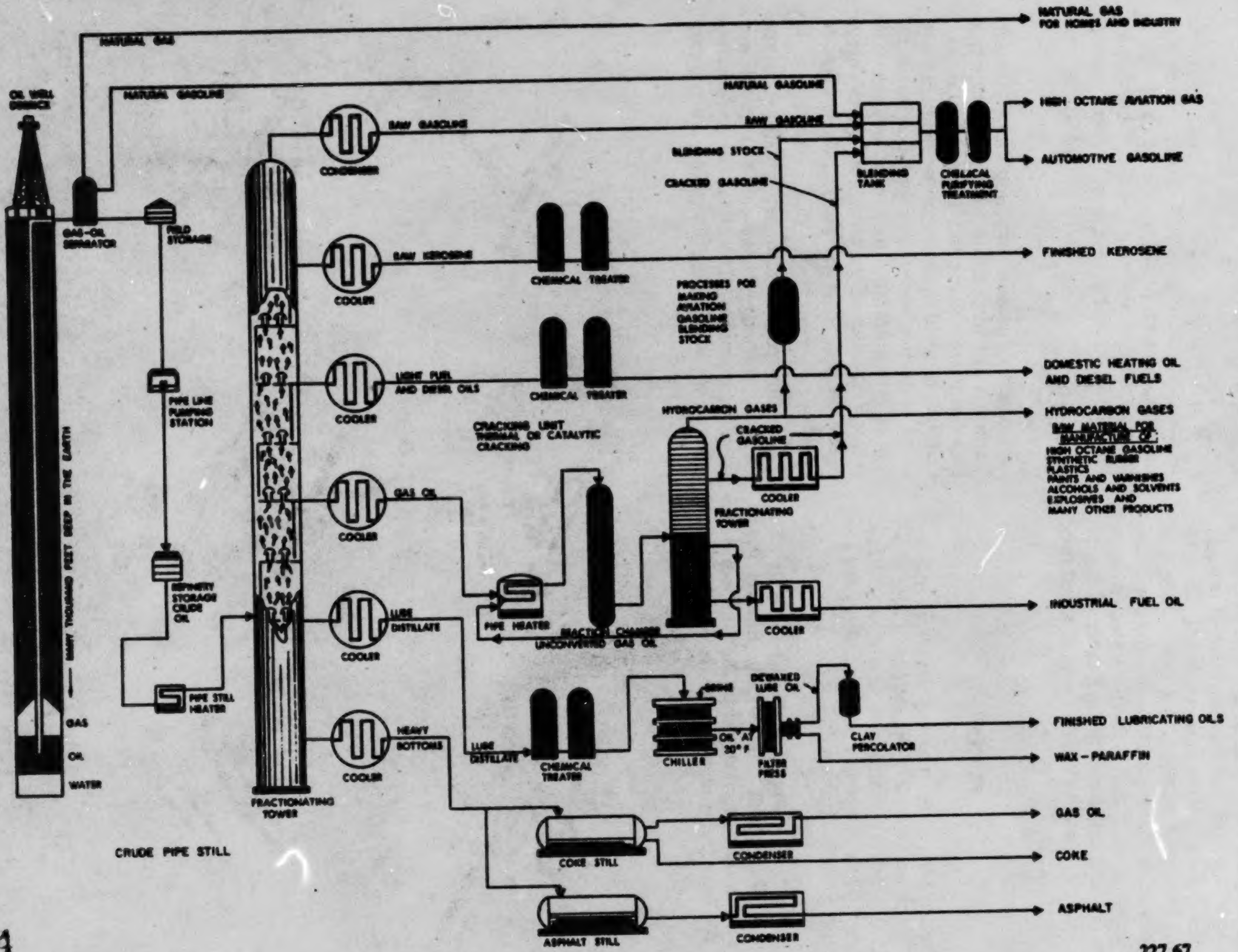
Gasoline contains two important elements (carbon and hydrogen) in such proportion that they burn freely in air and liberate heat energy. Gasoline is suited to engine operation because of its uniform rate of burning and easy vaporization to give quick starting in cold weather. The major properties of gasoline that affect engine operation are volatility, purity, and antiknock quality.

As applied to gasoline, volatility is the tendency to change from liquid to vapor at any given temperature. The volatility of gasoline affects ease of starting, length of the warmup



213.4

Figure 8-24.—Securing lines using support clamps.


NATURAL GAS
NATURAL GASOLINE
OIL WELL DERRICK
GAS-OIL SEPARATOR
FIELD STORAGE
PIPE LINE PUMPING STATION
REFINERY STORAGE CRUDE OIL
PIPE STILL HEATER
MANY THOUSAND FEET DEEP IN THE EARTH
GAS
OIL
WATER
CRUDE PIPE STILL
FRACTIONATING TOWER
CONDENSER
RAW GASOLINE
COOLER
RAW KEROSENE
CHEMICAL TREATER
LIGHT FUEL AND DIESEL OILS
CHEMICAL TREATER
COOLER
GAS OIL
COOLER
LUBE DISTILLATE
COOLER
HEAVY BOTTOMS
CRACKING UNIT THERMAL OR CATALYTIC CRACKING
PIPE HEATER
REACTION CHAMBER
UNCONVERTED GAS OIL
HYDROCARBON GASES
CRACKED GASOLINE
COOLER
FRACTIONATING TOWER
COOLER
NATURAL GASOLINE
RAW GASOLINE
BLENDING STOCK
CRACKED GASOLINE
BLENDING TANK
CHEMICAL PURIFYING TREATMENT
PROCESSES FOR MAKING AVIATION GASOLINE BLENDING STOCK
LUBE DISTILLATE
CHEMICAL TREATER
BRINE
CHILLER
OIL AT 30° F
DEWAXED LUBE OIL
FILTER PRESS
CLAY PERCOLATOR
COKE STILL
CONDENSER
ASPHALT STILL
CONDENSER
NATURAL GAS FOR HOMES AND INDUSTRY
HIGH OCTANE AVIATION GAS
AUTOMOTIVE GASOLINE
FINISHED KEROSENE
DOMESTIC HEATING OIL AND DIESEL FUELS
HYDROCARBON GASES
RAW MATERIAL FOR MANUFACTURE OF:
HIGH OCTANE GASOLINE
SYNTHETIC RUBBER
PLASTICS
PAINTS AND VARNISHES
ALCOHOLS AND SOLVENTS
EXPLOSIVES AND
MANY OTHER PRODUCTS
INDUSTRIAL FUEL OIL
FINISHED LUBRICATING OILS
WAX - PARAFFIN
GAS OIL
COKE
ASPHALT

227.67

Figure 8-25.—Flow chart tracing crude oil from well to finished products.

period, and engine performance during normal operation. As the temperature rises and the pressure against the surface of the gasoline decreases, the rate of vaporization increases.

To start readily, an engine must have a burnable air-fuel mixture in the combustion chamber at the moment of starting. The proper mixture during normal operating conditions is about 15 parts of air to 1 part of fuel by weight, but during starting, when an engine is cold, some of the vaporized fuel condenses and collects in the intake manifold. More fuel must be added to make enough fuel available for starting and operation until the engine reaches operating temperatures. Under extremely cold starting conditions the air-fuel ratio may be as low as 1 1/4:1 in order to obtain the necessary 15 parts of air to 1 part of combustible fuel. The change in ratios for starting is accomplished by the choke in the carburetor. Starting in cold weather can also be aided by using fuels of higher volatility.

Vapor lock is a difficulty encountered in using highly volatile fuels. This tendency increases as the temperature gets hotter. A fuel that has a tendency to vaporize at normal atmospheric temperatures may form so much vapor in the fuel lines that the action of the pump does not provide a flow of fuel to the carburetor but a flow of vapor. Insulation between the fuel lines, fuel pump, and carburetor, and the heat producing parts of the engine (exhaust manifold and pipe) helps to prevent vapor lock. The use of low volatility fuels in hot weather is the best preventive.

In case it is necessary to bleed the fuel line to remove vapor lock or contamination, disconnect the line from the tank at the fuel pump. Apply pressure to the tank and permit the fuel to flow into a container until the vapor lock is removed or the contamination has passed into the container. Reconnect the line to the inlet side of the fuel pump. If the first attempt is not successful, repeat the process.

Another undesirable condition results when cold weather or overchoking leaves excessive amounts of fuel unvaporized in the intake and combustion systems. The unvaporized fuel seeps by the valves and piston rings into the crankcase and lubricating oil during starting and warmup. This dilutes the oil in the crankcase and reduces its lubricating qualities. If the engine operating temperatures are high enough, the gasoline will be vaporized in the crankcase and be withdrawn through the crankcase ventilating system.

When fuel is not distributed evenly to all cylinders, the engine runs unevenly, and power output decreases. The fuel must be completely vaporized and mixed with air in the manifold before entering the cylinders to ensure good distribution. Quick, smooth acceleration also depends on a fully vaporized air-fuel mixture entering the combustion chamber.

The refining process removes many impurities from petroleum before gasoline suitable for engine use is produced. Considerable corrosion at one time was caused by sulfur inherent in crude oil, but modern refining procedure has made corrosion almost negligible. The tendency for the hydrocarbons in gasoline to combine with the oxygen in the air to form sticky gums which resulted in clogged carburetors, stuck valves, and other operational difficulties was another problem. Chemicals that control the gumming tendency are now added to the gasoline. Other impurities such as dirt, water, grease, and unwanted chemicals must also be removed to make gasoline an acceptable fuel.

To better understand what is meant by the antiknock quality of gasoline, let us first study the process of combustion. When the mixture in the combustion chamber of an engine cylinder is ignited, the gasoline vapor and the oxygen in the air unite in a rapid chemical reaction called burning. In burning, the molecules of the gasoline and oxygen are set into very rapid motion, and heat is produced. The molecules bombard the walls of the combustion chamber and the piston head. This bombardment is what actually registers the heavy push on the piston and forces it down on the power stroke. The normal combustion process goes through three stages that can be termed formation of a nucleus of flame, hatching out, and propagation.

As soon as the spark jumps the gap of the sparkplug electrodes, a small ball of blue flame develops in the gap. This ball is the first stage or nucleus of flame. It enlarges with relative slowness, and there is no measurable pressure created by heat during its growth.

As the nucleus enlarges, it develops into the hatching-out stage. The nucleus is torn apart so that it sends fingers of flame into the mixture in the combustion chamber. This causes enough heat to give just a slight rise in the temperature and pressure in the entire air-fuel mixture. A lag still exists in the attempt to raise the pressure in the entire cylinder.

It is during the propagation stage that effective burning occurs. The flame now burns in a front which sweeps across the combustion chamber, burning rapidly and causing great heat and a rapid rise in pressure. This pressure causes the piston to move downward. The burning during normal combustion is progressive. It increases gradually during the first two stages, but the flame is extremely strong as it sweeps through the combustion chamber during the third stage. However, there is no violent or explosive action such as when detonation takes place.

If detonation does take place, it occurs during the third stage of combustion. The first two stages are normal, but in the propagation stage the flame sweeps from the area around the spark plug toward the walls of the combustion chamber. As the flame races through the combustion chamber, the unburned gases ahead of it are further compressed and are heated to high temperatures. When the unburned mixture is compressed and heated to the point of self ignition, a rapid uncontrolled burning takes place that is almost an explosion and is called detonation. Knocking or pinging results. Detonation may cause malfunctions that range from loss in the performance to actual destruction of the engine. Pistons have been shattered, cylinders burst, and heads cracked in extreme cases. It is more likely that the engine will overheat, fuel consumption will be high, and a loss of power will result from detonation.

The AS can help prevent detonation by making sure the gasoline used in the engine is the manufacturer's recommended octane rating. The ability of a fuel to resist detonation is a measure of its octane rating. Normal heptane has an octane rating of zero, and iso-octane has an octane number of 100. When these two hydrocarbons are mixed in the proper proportions to cause the same degree of knocking in the test engine as the gasoline being tested, the proportion gives the octane number of the gasoline. For example, a gasoline rating 75 octane is equivalent in its knocking characteristics to a mixture of 75-percent iso-octane and 25-percent normal heptane.

The tendency of a fuel to detonate varies in different engines and in the same engine under different operating conditions. Engines are designed to operate within a certain octane range. Performance is improved with the use of higher octane fuel within the range if the spark setting is changed accordingly. The spark should be advanced when higher octane fuel is used; it should be retarded when lower octane fuel is used. If the engine operates satisfactorily at the upper limit of the range of the octane rating for its fuel, it will not improve the performance to use fuel of a higher octane number. Octane rating of fuel has nothing to do with starting qualities, potential energy, volatility, or other major characteristics.

Tetraethyllead is the most commonly used compound added to gasoline to suppress detonation. It is effective because it reduces the rate of burning of the fuel and thus prevents explosive burning or detonation. Most gasolines used in aviation support equipment contain amounts varying up to one part tetraethyllead to 1,600 parts gasoline. Improved refining methods also have produced fuels of greater antiknock quality.

Low octane fuel is not the only cause of detonation. It can be caused by anything that increases the heat or pressure applied to the last part of the air-fuel mixture in the combustion chamber. That is why the compression ratio of an engine has an upper limit. Due to the excessive heat and pressure caused by additional compression when the ratio is raised too high, detonation will result. We can assume that the gasoline delivered to the Navy is of the specified octane rating; therefore, if an engine is detonating, we must look for other causes. Under certain conditions, preignition, excessive spark advance, lean fuel mixture, and defective cooling systems are some of the causes of detonation. Preignition is the igniting of the air-fuel mixture in the combustion chamber during the compression stroke before the spark has occurred. This is caused by a hot spot in the combustion chamber. For example, an overheated exhaust valve head, a hot spark plug, or a buildup of carbon could be the cause of preignition. When the engine becomes overheated, a part of the combustion chamber may become red hot and, as the air-fuel mixture is compressed, ignite the mixture. Preignition may lead to detonation, but the two are separate and distinct events.

DIESEL

Diesel fuels are heavier than gasoline because they are obtained after gasoline and kerosene have been refined from the crude oil. The high speed diesel engines used in aviation support equipment require a fuel almost as light as kerosene. This diesel fuel has specification requirements as exacting as does gasoline. The most important qualities of diesel fuel are cleanliness, vicosity, and ignition quality.

Cleanliness is probably the most important and necessary property of a diesel fuel. The fuel should not contain any foreign substances because fuel pump and injector malfunction will result. Diesel fuel will hold dirt in suspension for longer periods of time than gasoline because it has a higher viscosity. Because of this, every precaution must be taken to keep dirt out of the fuel system or eliminate it before it reaches the pumps. Water is more objectionable in diesel fuel than in gasoline becauses it causes ragged performance and will corrode the fuel system. The least amount of corrosion on the highly machined surfaces of the injection system equipment will cause it to become inoperative.

When it is suspected that contamination has caused unsatisfactory performance of a diesel engine, disconnect all supply lines and blow them out with air. Reconnect the lines, and ensure that uncontaminated fuel is supplied to the system.

The viscosity of a fluid is an indication of its resistance to flow. The higher the viscosity, the greater the resistance to flow. The viscosity of diesel fuel must be low enough to flow freely at the lowest temperatures encountered but at the same time be high enough to properly lubricate the closely fitted pump and injector plungers. It must be viscous enough that leakage at the pump plungers and dribbling at the injectors will not occur. The viscosity of the fuel determines the size of the fuelspray droplets. This size governs the atomization and penetration qualities of the spray.

The ignition quality of a diesel fuel is its ability to ignite spontaneously under the conditions existing in the engine cylinder. The ignition quality is the delay between the time the fuel is injected into the cylinder and ignition by the hot air, and is expressed as a cetane number. The spontaneous ignition point of the fuel is a function of temperature, pressure, and time. The apparatus used for measuring the cetane number of a fuel is an actual diesel cylinder running under controlled operating conditions. The cetane number of a fuel is obtained by comparing the operation of the unknown fuel with a known reference fuel in a special test engine. The reference fuel is a mixture of alpha-methylnaphthalene (which will hardly ignite alone) and cetane (which will readily ignite at temperatures and pressures obtained in a diesel cylinder). The cetane number indicates the percent of cetane in a reference fuel which just matches the ignition properties of the fuel being tested.

Diesel engines knock, particularly when first started or when idling. This knock is due to the rapid burning of the charge of fuel accumulated during the delay period between the time of injection and ignition. When fuel is injected, the first portion must vaporize, then heat and pressurize until it reaches the spontaneous ignition point. Time is required for sufficient fuel to go through this cycle to permit ignition. During this same time, other portions of the fuel are being injected and are going through the same phases but behind the first portion. Therefore, as the flame spreads from the point of ignition many of the portions of the charge reach their spontaneous ignition temperatures at practically the same time. This rapid burning causes a very rapid increase in pressure which causes a distinct and audible knock. Increasing the compression ratio in the cylinder of the diesel engine will decrease the ignition lag and thereby decrease the tendency to knock. Speeding up the engine increases the compression ratio. The type of combustion chamber, airflow within the chamber, the type of nozzle, the injection pressure conditions, the fuel temperature, the air temperature, and the characteristics of the fuel are all factors that could affect knocking in a diesel engine. More can be done in the design of the diesel engine cylinder to eliminate detonation than can be done in a gasoline engine.

The cetane number of diesel fuels is usually between 30 and 60. Rapidly igniting fuels have high cetane numbers while slow igniting fuels have low cetane ratings.

JP-5

JP-5 fuel predominantly consists of hydrocarbons with a little more carbon and somewhat less hydrogen. It may contain as much as 4 pounds of sulfur per 1,000 lb of fuel.

Compounds containing only hydrogen and carbon release, when burned, the greatest amount of energy for a given weight of fuel. Thus, a fuel consisting only of hydrogen and carbon may produce 2-1/2 horsepower per hour for each pound of fuel burned by a piston engine.

Since JP-5 is a less volatile fuel than JP-4, it is now the Navy's primary jet fuel. It is safer to store, more thermally stable, and has higher heat content per gallon than JP-4.

JP-5 is a kerosene-type fuel with a vapor pressure close to 0 psi. Since it has a lower tendency to vaporize than the more volatile grades, the vapor-air mixture in tanks or containers above its liquid surfaces will generally be too lean to be ignited until the surface of the liquid reaches a temperature of about 140°F. JP-5 is used by all shipboard diesel-powered support equipment and gas turbine engines.

SAFE HANDLING OF FUELS

JP-5 fuel does not contain tetraethyllead. However, it may contain more toxic aromatics than gasoline. It should, therefore, be handled with the same health precautions as apply to gasoline. The hygienic or health aspects for gasoline, therefore, apply equally as well to JP-5. This includes precautions covering inhalation of vapors, skin irritations, and container hazards.

Jet engine fuels are petroleum products manufactured from crude oil by oil refineries. They are classified as flammable liquids. This means that they will burn when ignited. Under proper conditions they will explode with forces similar to those of TNT or dynamite. Death can result if the vapors of fuel are inhaled in sufficient quantities, and serious skin irritations can result from contact with the fuel in the liquid state. In liquid form fuels are lighter than water, and in the vapor form they are heavier than air. Consequently, any water present in the fuels will usually settle to the bottom of the container. On the other hand, vapors of these fuels, when released in the air, tend to remain close to the ground, thus increasing the danger to personnel and property. From safety and health standpoints jet engine fuels must be handled with caution. On rags or waste they are very flammable.

The Standard First Aid Training Course, NAVEDTRA 10081-C, should be studied by all personnel working with fuels for information on the treatment of those overcome or injured due to the handling of fuels.

LUBRICANTS

The primary purpose of any lubricant is to reduce friction and eliminate metal-to-metal contact during the operation of the engine. Lubricants provide a film which permits surfaces to slide over each other with less friction. Therefore, lubrication is essential to prevent wear in any mechanical device where there are surfaces rubbing against each other.

OILS

In internal combustion engines, lubricating oils must perform four basic functions: lubrication, cooling, cleaning, and sealing. In order to properly lubricate the engine parts the oil must be of low enough viscosity to flow readily between closely fitted parts that move rapidly but of high enough viscosity to prevent metal-to-metal contact between the parts. It must have a low enough pour point (lowest temperature at which it can be poured) to lubricate during starting under very low temperatures. The flashpoint of oil is the temperature at which it first gives off sufficient flammable vapor to ignite; this temperature ranges from 275° to 700°F. The fire point is the temperature at which the vapor will continue to burn and is usually 50° to 70° higher than the flashpoint. Lubrication oil must have high enough flash and fire points so that it will not burn, vaporize, or be consumed under high heat and be tough enough so that it will not break down or fail under high temperatures or pressures. The oxygen absorption of the oil must be low enough so that varnish and gum do not form, and the oil must have small enough acid content so as not to be detrimental to engine parts.

Lubricating oil must cool moving parts by carrying off waste heat. This is especially true in diesel engines. Diesel engines generate enough heat of combustion that an oil cooler is used to transfer the heat from the oil to another medium. In order to perform its cooling function, lubricating oil must be able to flow readily.

Another major function of lubricating oils is cleaning. This means carrying from the engine parts dirt, dust, small carbon and metal particles, gum, and varnish. Because of the increased compression ratios, higher speed engines, high operating temperatures, and closer tolerances, cleaning has become increasingly important in recent years. Filters have been developed to remove part of the dirt and ventilation systems have been designed to carry off vapors and moisture. However, these devices perform only part of the job. Therefore, additives or detergents are blended with lubricating oils. The detergent is soluble in the oil and cleans the dirt, gum, and other impurities from the engine and holds them in suspension. These suspended impurities are removed by the filter as the oil is circulated. Gum and varnish are not removed by the filter and therefore, the oil must be changed at intervals. If the oil is not changed, the amount of gum and varnish increases to the point where the oil can no longer hold them in suspension and these substances are deposited throughout the engine and cause poor performance.

Another function of lubricating oil is to seal the space between the piston rings, cylinder walls, and pistons to prevent leakage of combustion gases from the combustion chamber, past the rings, into the crankcase. When this space is properly sealed by the lubricating oil, the full force of the combustion is expended on the head of the piston and none of the force is lost.

Types and Designations

The military specification for lubricating oils for aviation ground support equipment prescribes that the oil be a petroleum or synthetically prepared product or a combination thereof. This oil is intended for the lubrication of internal combustion automotive equipment and for general purpose lubrication. This oil is of three viscosity grades: SAE10, SAE30, and SAE50. The SAE stands for the Society of Automotive Engineers who have established an arbitrary system for classifying motor oils according to their viscosities.

Other parts of the aviation support equipment use lubricating oils, in addition to the engine. These are the transmission, differential, and steering gear unit. A standard transmission uses SAE80 or SAE90 grade oil. This oil can also be used in the differential and steering gear unit. The manufacturer's recommended grade of oil should always be used in all three parts. The desirable qualities of a gear lubricant are high viscosity index, proper viscosity, chemical and thermal stability, and freedom from foaming. The viscosity index of an oil is the effect of change of temperature on the viscosity of the oil. A low viscosity index signifies a large change of viscosity with changes in temperature. For example, an oil that becomes very thin at high temperatures and very thick at low temperatures will have a low viscosity index. If uncompounded mineral oils were used in modern gear systems, they would fail in a short time because of the great friction generated and the high loads carried. Therefore, oiliness additives and extreme pressure agents are added to the mineral oil. Extreme pressure agents produce a nonscuffing film on the gears which increases the amount of load the gears can carry.

The oil used in an automatic transmission more closely resembles hydraulic fluid than lubricating oil. However, only automatic transmission oil should be used in automatic transmissions. This oil has been specially prepared for use in modern day automatic transmissions.

Turbine Oil

MIL-L-23699B is a synthetic base lubricating oil used in the lubricating system of support equipment gas turbine engines. This oil has two principal advantages over petroleum oil. It has less tendency to lay down lacquer and coke deposits and less tendency to evaporate at high temperatures. Its principal disadvantage is that it tends to blister or remove paint wherever it is spilled. Painted surfaces should be wiped clean with a petroleum solvent after spillage.

GREASES

Grease is used where oil cannot perform the desired lubrication. On aviation support equipment, grease is used in front wheel bearings and for chassis lubrication. The most important requirements of greases are stability, noncorrosiveness, water resistance, and satisfactory performance in operation. A grease must be stable both in storage and in use. It must be free from bleeding (separation of oil), oxidation, and changes in consistency. The grease must not chemically attack the metals and other materials with which it comes in contact. A grease which is insoluble in water is required in some cases, while in others the grease must only resist weathering or the washing action of water.

Various soaps are used in the manufacture of grease. These soaps regulate the water resistance and the heat stability of the grease. A grease must perform satisfactorily in the equipment for which it is intended, or inadequate lubrication will result. Always use the grade of grease recommended by the equipment manufacturer.

HYDRAULIC FLUIDS

Hydraulic fluid is used in brake systems, power steering, work stands, ordnance trucks (bomb lifting systems, both self-propelled and towed), aircraft spotting dollies, and forklifts. The necessary properties of a hydraulic fluid are to have chemical stability, freedom from acidity, lubricating ability, proper viscosity, a minimum of toxicity, and a high flashpoint. It should not undergo chemical changes that will form unfavorable deposits that clog openings or cause sticking or leaking of moving parts during severe operating conditions. Hydraulic fluids should be free from acids that would corrode or otherwise adversely affect the metals and nonmetal lines composing the system. Since moving parts are involved in the hydraulic system, the hydraulic fluid should have the ability to lubricate these moving parts. The viscosity of the hydraulic fluid must permit it to give a good seal at pumps, valves, and pistons and still permit it to flow easily under all operating conditions. Hydraulic fluid should be free from any chemical that is poisonous or toxic to the human being. Resistance to combustion and minimum evaporation are desirable qualities of hydraulic fluids and are indicated by a high flashpoint.

Several different types of hydraulic fluids are used in support equipment. The manufacturer of the equipment recommends the specification to be used in each system. The most commonly used hydraulic fluid is Specification MIL-H-83282. This is the same type of fluid that is used in aircraft hydraulic systems. The fluid is colored red and is normally procured in 1-quart and 1-gallon containers, also colored red. MIL-H-83282 hydraulic fluid has a petroleum base and must not be mixed with vegetable base hydraulic fluid.

Vegetable base hydraulic fluid is used in the brake systems of some self-propelled support equipment. When petroleum or mineral base hydraulic fluid is mixed with vegetable base hydraulic fluid in a system, the two will jell and make the system inoperative. Using a petroleum base hydraulic fluid in a vegetable base hydraulic system will cause the natural rubber seals to decompose and clog the system and also cause the seals to leak. Vegetable base hydraulic fluid has no deteriorating effect on the petroleum base hydraulic synthetic rubber seals. Be sure the hydraulic fluid you add, or with which you refill a system, is the type for which the system is designed.

Cleanliness is the most important factor in the maintenance of a hydraulic system. Small orifices and close clearances in the hydraulic system make all forms of dirt a positive hazard. The usual cause of foreign matter in the system is carelessness of those who service the system. When adding fluid to the system make certain that the manufacturer's recommendation is followed as to the type. Also ensure that no dirt gets in the reservoir when the cap is removed.

HANDLING PETROLEUM PRODUCTS

SAFETY

Hazards in handling petroleum products are usually confined to handling gasoline. Vapors from all petroleum products are hazardous because they constitute fire and explosive hazards, and they are toxic to the human body. When petroleum products, even gasoline, are stored in a closed can or tank they are not hazardous because no vapor (or very little) escapes from the container. To use the petroleum product it must be handled, and this permits vapors to form. Since the vapors from petroleum products create the greatest hazard, the vapor characteristics should be understood. Vapors from petroleum products, especially gasoline, have been known to travel some distance, reach a source of ignition, and flash back to the point of origin causing a fire. Vapors from petroleum products are heavier than air and settle in low places, such as lubrication pits, where they remain until ventilated out. Spilled gasoline or diesel fuel vaporizes quickly because so much of the liquid is exposed to the air; therefore, when spilled it should be cleaned up as soon as possible.

Gasoline is volatile because it gives off flammable vapors at comparatively low temperatures. Volatile products such as gasoline are normally handled at temperatures where they give off sufficient vapors to burn at all times. Therefore, the AS must be extremely cautious when fueling aviation support equipment with gasoline. Caution is also required when handling other petroleum products but not to the same degree as in handling gasoline.

A hazard to persons handling petroleum products is the toxic effect of the vapor. Petroleum vapors, when breathed in a concentration of one-tenth of one percent by volume, may cause dizziness at the end of 6 minutes. Concentration of one-half of one percent can cause the inability to walk straight in 4 minutes. Longer exposure or greater concentration may cause unconsciousness or death.

The first symptoms of breathing toxic vapors are headaches, nausea, and dizziness. Recovery from the early symptoms is usually prompt after removal to fresh air. If a man becomes unconscious because of breathing petroleum vapors, he should receive immediate medical attention.

The hazard of heavy concentrations of vapors from gasoline is increased if the gasoline contains tetraethyllead which is added for antiknock purposes. This lead compound is inhaled with the fumes or may enter the body through the mouth or by absorption through the skin. No matter how it enters the body, tetraethyllead is poisonous. Although the amount of tetraethyllead blended with automotive gasoline is very small, lead poisoning may occur from repeated exposure to gasoline vapors in an enclosed or inadequately ventilated area where leaded gasoline has been spilled in considerable quantity. If operating personnel are continually exposed to leaded gasoline, they should be rotated on the job in order to limit the period of individual exposure. A better solution is to provide sufficient ventilation to remove the hazard.

Volatile products such as gasoline may cause skin irritations if allowed to remain in contact with the skin, particularly under soaked clothing and gloves. Clothing or shoes should be removed at once if any fuel has soaked through them. After clothing removal, the skin should be washed with soap and water. If the skin is subjected to repeated contact with gasoline, the protective oils are removed from the skin and drying, roughing, cracking, and possibly infections of the skin result. Oil-resistant rubber gloves should be worn as protection by those handling petroleum products.

If volatile fuel gets into the eyes, first aid should be given immediately. Thoroughly wash the eyes with water, apply sterile olive oil, castor oil, or mineral oil to the eye and secure medical attention as soon as possible. If a petroleum product is swallowed, immediately give the victim a large quantity of warm, salty water to drink in order to induce vomiting. Medical attention should be secured as soon as possible.

STORAGE

Petroleum products are stored in cans, drums, and tanks. Gasoline and diesel fuel are usually stored in drums or tanks. Lubricating oils are usually stored in cans or drums. Grease and hydraulic fluid are usually stored in cans.

Because gasoline is very flammable it should be stored outside. The safest method of storage is in an underground ventilated tank. The aviation support equipment is then serviced by a pump similar to those used in civilian service stations everywhere. The storage tank may be mounted on a truck. The truck engine will then supply the power to run the pump to move the fuel to the equipment serviced. If stored in drums, the gasoline is removed by a hand operated pump or by gravity draining, depending on facilities available. Regardless of the method of storage, spillage while servicing equipment becomes a problem. Vapors of gasoline may be ignited by the vehicle serviced when it is started. If much spillage results from servicing the vehicle it should be flushed away with water before the vehicle is started. The fueling area should be posted with signs prohibiting smoking or any open flame. Adequate fire-fighting equipment should be available in the fueling area. Dry chemical and CO_2 fire extinguishers are the best for petroleum product fires. To eliminate static electric sparks that can ignite gasoline vapors while being fueled, the equipment should be grounded. If fueling from a tank truck, the truck should also be grounded. A wire or chain securely fastened to the tank truck or vehicle and extending to the deck is considered sufficient grounding. Aboard ship, gasoline is usually stored in drums. The gasoline is transported in cans to the equipment being fueled.

Safety cans are designed for the safe handling of gasoline in quantities up to 10 gallons. These cans are made for use inside where no provision has been made for a special storage room of proper construction. They can also be used to transport gasoline outside. Each can is cylindrical in form and has a self-closing valve which is opened through a valve actuating linkage by manual pressure applied to either the carrying handle or an independent control lever. Internal pressure in excess of 5 pounds per square inch is relieved either through an independent pressure relief valve or by overcoming the spring pressure on the pouring closure or the filling closure. Both the filling and pouring openings are provided with double screens of such design that they serve as flashback arresters in the event that the flammable vapor should ignite outside the can. These screens can be readily removed and replaced without forcing, thus facilitating frequent inspection and cleaning. The valves are leakproof, so the can, when filled with liquid, can be inverted without danger of leakage. The stability of the can is such that it will not tip over of its own accord when it contains liquid and is tilted 30 degrees from the horizontal.

Preventive measures are always more safe than corrective measures. Therefore, if no spillage occurs and no unsafe handling practices are permitted, danger is held to the minimum.

Diesel fuel ashore is usually stored in skid-mounted tanks outside. Aviation support equipment can be fueled from the tank by gravity feed. Though diesel fuel is not as flammable as gasoline, the same precautions should be followed as have been listed for handling gasoline. Diesel fuel aboard ship is stored in drums, and the fueling of equipment is performed in the same way as with gasoline.

Lubricating oils are stored in drums or cans. When stored in drums, the drum is usually fitted with a faucet to permit the oil to be drained into containers for transportation to the equipment where it is needed. When oil comes in cans, a pouring spout can be inserted for pouring into the equipment. Lubricating oils can be stored inside.

Grease and hydraulic fluid are usually supplied in cans. The cover or cap of the can should always be replaced to prevent any foreign matter getting in the unused portion. Grease and hydraulic fluid can be stored inside.

CONTAMINATION

It has already been stated that contamination in petroleum products should be avoided. Where unused petroleum products are stored in drums or cans they should be tightly closed to prevent dirt from entering the container. Every precaution should be taken to prohibit foreign matter from getting in gasoline, diesel fuel, lubricating oil, or hydraulic fluid. Where it is suspected that the fluid is contaminated it should be filtered before using.

Empty drums and reusable cans not immediately scheduled for refilling with the same fluid should be cleaned before storage. Empty containers should be protected from careless handling and from contamination of the interior. They should be tightly closed, as this will also retard interior corrosion to a great degree. If the container shows evidence of corrosion, it should be scheduled for possible reclamation. Empty containers having contained flammable or explosive products should be treated as a hazard and handled as such until reconditioned or cleaned.

SUMMARY

In the preceding chapter, we discussed the importance of using the proper tools to perform maintenance tasks. In this chapter we have discussed the various materials (hardware, fuels, lubricants, and hydraulic fluids) which are important factors in any maintenance effort. We have purposely omitted sheet metal, welding materials, and electrical parts as they will be treated in a later text. Be aware that the use of improper (wrong specification) oil or SP fuel will not only create additional maintenance problems, but also create safety problems.

CHAPTER 9

GROUND SUPPORT EQUIPMENT CORROSION CONTROL

The reliability and effectiveness of support equipment depend largely upon the structural soundness of the metals which make up their many parts. One great threat to structural integrity of support equipment is metal corrosion. Support equipment may be used in a variety of climatic and atmospheric conditions which range from the hot dry desert to the hot humid tropics to the cold arctic regions. In addition, the equipment is most often used in the salt filled atmosphere such as coastal shore bases, on islands, and especially on aircraft carriers. Shipboard and coastal GSE are subjected to the effect of sea winds that can carry 10 to 100 pounds of salt per cubic mile of air. These difficult environmental conditions vary the speed and intensity of metal corrosion.

Corrosion reduces the strength of materials and the strength of joints between parts. Most equipment is designed with an extra margin of strength for safety. Corrosion can weaken the structure thereby reducing or eliminating this safety factor. Replacement or reinforcement operations are costly, time-consuming, and reduce usage of the equipment. Severe corrosion can cause failure of parts or systems. Such malfunctions can cause an important item of equipment to become inoperative during very critical demands.

You must know and be able to apply the common types of corrosion prevention and moisture protecting materials. To accomplish this you must be familiar with the types and causes of corrosion, types and uses of cleaning materials, materials and procedures for preservation and depreservation, and the means for the detection of corrosion.

CAUSES OF CORROSION

Metal corrosion is the deterioration of metals as they combine with oxygen to form metallic oxides. This combining is a chemical process which is essentially the reverse of the process of smelting the metals from their ores. Very few metals occur in nature in the pure state. For the most part they occur naturally as metallic oxides. The oxides may also be mixed with other undesirable impurities in the ores. The refining process generally involves the extraction of relatively pure metal from its ore and the addition of other elements (either metallic or nonmetallic) to form alloys.

After refining, alloys and metals possess a potential or tendency to return to their natural state. However, potential is not sufficient in itself to initiate and promote this reversion. The metals must be in a corrosive environment, in which the significant element is oxygen. It is the process of oxidation—combining with oxygen—that causes wood to rot or burn and metals to corrode.

Control of corrosion depends on maintaining a separation between the metal and the corrosive environment. This separation is accomplished in various ways. A good coat of paint provides almost all of the corrosion protection on support equipment. Sealants are used at seams and joints to prevent entry of moisture, and preservatives are used on unpainted surfaces. Tarpaulins, covers, and caps also provide varying degrees of protection. None of these, however, provides 100 percent protection. Paint is subject to oxidation and decay through weathering; sealants may work out by vibration or else be eroded by rain and wind. Preservatives at best offer only temporary protection when used on operating equipment and the covers are subject to improper installation, leakage, and neglect.

Control of corrosion properly begins with your understanding of its causes and its nature. Corrosion is caused by electrochemical or direct chemical reaction of metal with the oxidizing agent. In the direct chemical attack, the reaction is similar to that which occurs when acid is applied to bare metal. Corrosion in its most familiar form is a reaction involving metal and water and is electrochemical in nature.

In the electrochemical attack, metals of different potential are involved and they need not be in direct contact. When one metal contains positively charged ions and the other negatively charged ions and an electrical conductor is bridged between them, current flows as in the discharge of a dry cell battery. In electrochemical corrosion, the conductor bridge may be any material dissolved in water, such as salt, dirt, or any debris that is capable of acting as an electrolyte. (An electrolyte is a nonmetallic conductor in which current is carried by the movement of ions.) Salt in any solution tends to accelerate the current flow and hence speed the rate of corrosive attack.

Once the electrical circuit is made, the electron flow is toward the negatively charged metal (cathode), and away from the positively charged metal (anode) which is eventually destroyed. All preventive measures taken to aid in corrosion control are designed primarily to avoid the establishment of the electrical circuit, or secondly, to remove it as soon as possible after contact before serious damage can result. Figure 9-1 illustrates electron flow through an electrolyte resulting in destruction of the anode area. Note that the surface of a metal, especially alloys of the metal, may contain minute anode and cathode areas due to impurities or alloying constituents which have different potentials from the base metals. Grain structure, a product of heat treatment, and the manufacturing process, also affects the tendency of metals to corrode.

Electrochemical attack takes several forms, depending upon the metal involved, its size and shape, its specific function, atmospheric conditions, and the type of corrosion-producing agent (electrolyte) present. There are many forms of metal deterioration resulting from electrochemical attack about which a great deal is known. But despite extensive research and experimentation, there is still much to be learned about other more complex and subtle forms. Descriptions are provided later in this chapter for the more common forms of corrosion which may be found on ground support equipment.

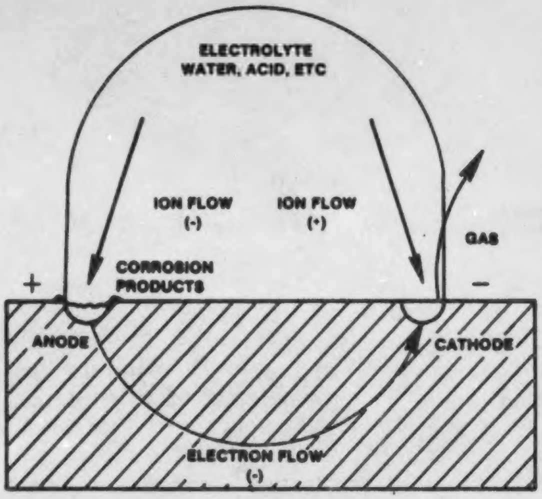


Figure 9-1.—Model corrosion cell.

The probability that a metal will corrode, given the necessary conditions, is related to its electrochemical stability in a corrosive environment. Table 9-1 "Galvanic Series of Selected Metals in Seawater", lists several common metals from the most active (anodic) to the least active (cathodic) in seawater. Note that iron and aluminum alloys (common metals used in the construction of GSE), are corrosion prone when unprotected in a marine environment.

Since so many factors contribute to the process of corrosion, selection of materials by the equipment manufacturer must be made with required properties and qualities, such as hardness, malleability, elasticity, strength, etc., as the primary consideration, and corrosion-resistant properties as the secondary consideration. However, close attention during equipment design and production is given to heat treating and annealing procedures, protective coatings,

Table 9-1.—Galvanic series of selected metals in seawater

ACTIVE (ANODIC) ↓
Magnesium (Mg)
Mg Alloy AZ-31B
Mg Alloy HK-31A
Zinc (pl. hot-dip, die cast)
Beryllium (hot pressed)
Aluminum (Al) 7072 cl. on 7075
Al alloy 2014-T3
Al alloy 1160 H14
Al alloy 7079-T6
Cadmium (pl.)
Uranium (depl.)
Al alloy 218 (die cast)
Al alloy 5052-0
Al alloy 5052-H12
Al alloy 7151-T6
Al alloy 5456-0, H353
Al alloy 5052-H32
Al alloy 1100-0
Al alloy 3003-H25
Al alloy 6061-T6
Al alloy 7071-T6
Al alloy A360 (die cast)
Al alloy 7075-T6
Al alloy 1100-H14
Al alloy 6061-0
Indium
Al alloy 2014-0
Al alloy 2024-14
Al alloy 5052-H16
Tin (pl.)
Stainless steel 430 (active)
Lead
Steel 1010
Iron, cast
Stainless steel 410 (active)
Copper (pl.)
Nickel (pl.)
Chromium (pl.)
Tantalium
Stainless steel 350 (active)
Stainless steel 310 (active)
Stainless steel 304 (active)
Stainless steel 430 (passive)
Stainless steel 410 (passive)
Stainless steel 17-7 pli (active)
(Cont)
Tungsten
Niobium (Columbine) 1% Zr
Brass, yellow, 268
Cranium (depl.) 8% Mo.
Brass, Naval, 464
Yellow Brass
Muntz metal 280
Brass (pl.)
Nickel-silver (18% Ag)
Stainless steel 316L (active)
Bronze 220
Everdur 655
Copper 110
Red brass
Stainless steel 347 (active)
Molybdenum, Comm pure
Copper-Nickel 7151
Admiralty brass
Stainless steel 202 (active)
Bronze, phosphor 534 (B-1)
Stainless steel 202 (active)
Monel
Stainless steel 201 (active)
Steel alloy Carpenter 20 (active)
Stainless steel 321 (active)
Stainless steel 316 (active)
Stainless steel 309 (passive)
Stainless steel 17-7 pli (passive)
Stainless steel 304 (passive)
Stainless steel 321 (passive)
Stainless steel 201 (passive)
Stainless steel 286 (active)
Stainless steel 316L (passive)
Steel alloy AM355 (active)
Steel alloy 202 (active)
Steel alloy, Carpenter 20 (passive)
Steel alloy AM350 (passive)
Steel alloy 286 (passive)
Titanium 5A1, 2.5 Sn.
Titanium 13V, 11Cr, 3A1. (annealed)
Titanium 8Mm.
Titanium 3A1, 13V, 11Cr (h.t + aged)
Titanium 75A
Stainless steel 350 (passive)
Graphite
LESS ACTIVE (CATHODIC) ↑

choice and application of moisture barrier materials, dissimilar metals contact, and also to access doors and plates. In other words, every logical protection is taken by the equipment manufacturers to prevent the onset and spread of corrosion attack.

After the equipment has been manufactured, preventive maintenance factors such as inspection, cleaning, painting, and preservation are within the control of the maintenance activity. They offer the most positive means of corrosion deterrence.

The electrochemical reaction which causes metal to corrode is a much more serious factor under wet, humid conditions. The salt, both in seawater and in the air is the greatest single cause of corrosion of ground support equipment. Hot climates speed the corrosion process because the electrochemical reaction develops most rapidly in a warm solution, and warm moisture in the air is usually sufficient to start corrosion if the metals are not coated. As would be expected, hot dry climates usually provide relief from constant corrosion problems. Extremely cold climates produce corrosion problems if a salt atmosphere is present. Melting snow or ice provides the necessary water to begin the electrochemical reaction.

The factors that influence corrosion are: the type of metal, the grain direction, manufacturing and operational stress, heat treatment, dissimilar metals coupled together, and operational environment. Of these, operational environment is the major factor causing corrosion. Moisture and salt are the two most common types of environmental elements causing the development of corrosion on GSE.

At sea in the early morning, you can run your hand over the cool surface of any metal structure or equipment and feel damp, slippery film. This is a thick solution of brine, produced by salt spray and salty water vapor that condensed during the night, and began to evaporate after the sun came up. This brine is a very strong electrolyte. It is not only on the surface of the equipment, it also forms to some extent any place exposed to sea air. A morning washdown is the first precaution against corrosion resulting from this concentrated brine electrolyte. Canvas and other covers are useful in retarding the formation of this film, but you must realize they are not 100% effective. Additionally, covered equipment must be wiped down from time to time.

APPEARANCE OF CORRODED PARTS

An important part of corrosion control is recognizing corrosion when it occurs. The following paragraphs include brief descriptions of typical corrosion product characteristics of the more common materials that are used in construction of ground support equipment.

IRON AND STEEL

Possibly the best known and easiest recognized of all forms of metal corrosion is the familiar reddish-colored iron rust. When iron and its alloys corrode, dark iron oxide coatings usually form first, and these coatings, such as heat scale on steel sheet stock, may protect iron surfaces rather efficiently. However, if sufficient oxygen and moisture are present, the iron oxide is soon converted to hydrated ferric oxide, which is common red rust.

ALUMINUM

Pure aluminum is very resistant to corrosion, but is too soft and weak for most applications. Aluminum alloys exhibit a wide range of corrosive attack, varying from general etching of surfaces to penetrating attacks along the internal grain boundaries of the metal. The corrosion products of aluminum are white to gray powdery aluminum hydroxide deposits.

MAGNESIUM

Magnesium and magnesium alloy corrosion produce white blisters or puffs on the base metal being corroded. The deposits have a tendency to raise slightly and the corrosion spreads rapidly. When white puffy areas are discovered on magnesium it requires prompt attention as the corrosion may penetrate entirely through the structure in a very short time.

COPPER AND COPPER ALLOYS

Copper and its alloys are generally corrosion resistant, although the products of corrosion attack on copper are commonly known. Sometimes copper or copper alloy surfaces tarnish to a dull gray-green color or a dull brown and the surface may still be relatively smooth. This discoloration is the result of the formation of a fine-grained, airtight copper oxide crust, called a patina. This patina in itself offers good protection for the underlying metal in ordinary situations. However, exposure of copper and copper alloys to moisture or salt spray causes the formation of blue or green salts indicating active corrosion. These salts form over the patina since the crust is not moisture-proof. Copper alloys used in support equipment have a cadmium-plated finish to prevent surface staining and deterioration.

CADMIUM AND ZINC

Zinc and cadmium are very often used as a coating to protect the part to which they are applied and to provide a compatible surface when the part is in contact with other materials. The zinc or cadmium plate supplies protection to the underlying metal because of its greater activity. That is, during the time it is protecting the base metal, the cadmium is attacked first, leaving the base metal free of corrosion. Attack is evident by a white to brown to black discoloration of the surfaces. These indications DO NOT indicate deterioration of the base metal. Until the characteristic colors peculiar to corrosion of the base metal appear, the cadmium or zinc is still performing its protective function. Wire brushing or removal of the stained areas of the cadmium or zinc merely reduces the amount of cadmium or zinc remaining to protect the underlying structure.

NICKEL AND CHROMIUM ALLOYS

These metals are also used as protective agents, both in the form of electroplated coatings and as alloying constituents with iron or stainless steels. Nickel and chromium platings protect by forming a noncorrosive barrier over the steel. Electroplated coatings, particularly chromium on steel, are somewhat porous, and corrosion eventually starts at these pores or pinholes unless a supplementary coating is applied and maintained. Table 9-2 also lists these and other types of metals and their corrosion products.

FORMS OF CORROSION

From the variety of corrosion products we have described, you can see that corrosion occurs in several forms, depending upon the metal involved. The nature of corrosion also depends on the corroded surface's size and shape, its specific function, atmospheric conditions, and corrosion-producing agents present. The forms of corrosion described in this section are commonly found on the various metals of ground support equipment.

The skilled Aviation Support Equipment Technician must be capable of examining corroded equipment and identifying corrosion types. Once identified, the individual types of corrosion can be treated. The following is a list of the types of corrosion most often associated with GSE:

a. Direct surface attack

b. Galvanic (or dissimilar metal corrosion)

c. Intergranular attack

d. Exfoliation

e. Pitting

f. Concentration cell (or crevice attack)

g. Fretting corrosion

h. Stress corrosion cracking

i. Corrosion fatigue

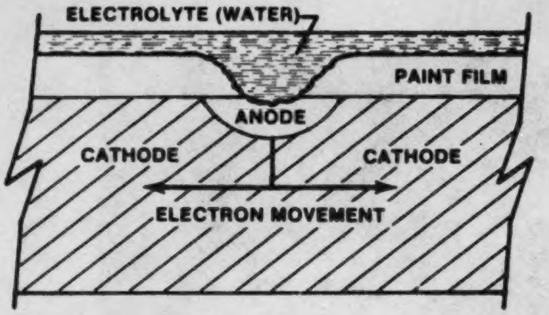
j. Microbiological corrosion.

Table 9-2.—Corrosion of metals—nature and appearance of corrosion products

ALLOY	TYPE OF ATTACK TO WHICH ALLOY IS SUSCEPTIBLE	APPEARANCE OF CORROSION PRODUCT
Carbon and Low Alloy Steel (1000-8000 series)	Surface oxidation and pitting, surface and intergranular.	Reddish-brown oxide (rust).
Stainless Steel (300-400 series)	Intergranular corrosion. Some tendency to pitting in marine environment (300 series more corrosion resistant than 400 series).	Corrosion evidenced by rough surface; sometimes by red, brown or black stain.
Aluminum Alloy	Surface, pitting, intergranular, and exfoliation.	White or gray powder.
Titanium Alloy	Highly corrosion resistant. Extended or repeated contact with chlorinated solvents may result in embrittlement. Cadmium plated tools can cause embrittlement of titanium.	No visible corrosion products.
Magnesium Alloy	Highly susceptible to pitting.	White powdery snowlike mounds, and white spots on surface.
Chromium (used as a wear-resistant plating for steels)	Subject to pitting in chloride environments.	Chromium, being cathodic to steel, does not corrode itself, but promotes rusting of steel where pits occur in the coating.
Cadmium (used as a protective plating for steel)	Caution should be observed in replating high stressed parts as embrittlement and ultimate failure may occur.	White, powdery corrosion products.
Copper-Base Alloy, Brass, Bronze	Surface and intergranular corrosion.	Blue or blue-green powder deposit.
Nickel-Base Alloy (Inconel)	Generally has good corrosion resistant qualities. Sometimes susceptible to pitting.	Green powdery deposit.
Tin	Subject to whisker growth.	Whisker-like deposits.

DIRECT SURFACE ATTACK

Direct surface attack appears as corrosion products distributed evenly over the entire metal surface. This most common corrosion is the result of surface exposure to the environment. Rusting iron plate or sheet is an example of this corrosion form. When protective paint layers are destroyed by the effects of saltwater spray, wind erosion, engine exhaust, and normal operational wear, contaminants such as dust, sea salt, and grease help to advance the corrosion process by trapping moisture at the metal



Direct surface attack is usually a result of nicked or chipped paint.

Figure 9-2.—Direct surface attack (model).

surface. Figure 9-2 illustrates a direct surface attack on steel. Note that this type of attack is initiated by a break or defect in the paint surface. In addition, figure 9-3 shows an example of advanced direct surface corrosion.

NOTE: Direct surface attack is sometimes referred to as uniform etch because it appears as a general etching of exposed surface areas.

UNIFORM ETCH CORROSION

The surface effect produced by most direct chemical attacks is a uniform etching of the metal. On polished surfaces this type of corrosion is first seen as a general dulling of the surface. If such corrosion is allowed to continue, the surface becomes rough and possibly frosted in appearance.

MICROBIOLOGICAL CORROSION

The growth and accumulation of microorganisms aid in the formation of corrosion by blocking drainage holes, deteriorating weather seals around enclosures, and trapping moisture against metal surfaces. The effects of microbiological corrosion are most evident in electronics. Moisture seals that have been rendered ineffective by microbiological attack permit the introduction of corrosion on interior components of instruments. This attack is critical to electronics where only a small amount of corrosion can cause part failure.

Microorganisms contained in unpure water can be introduced into fuel systems by contaminated fuel. These fungus growths attack any sealing material that might be used in fuel tanks. Under certain conditions, they can cause corrosion of aluminum by aiding in the formation of concentration cells. Slimy residues resulting from biological growth tend to clog fuel filters. Specific fuel additives are available to inhibit development of microorganisms in fuel tanks and systems.

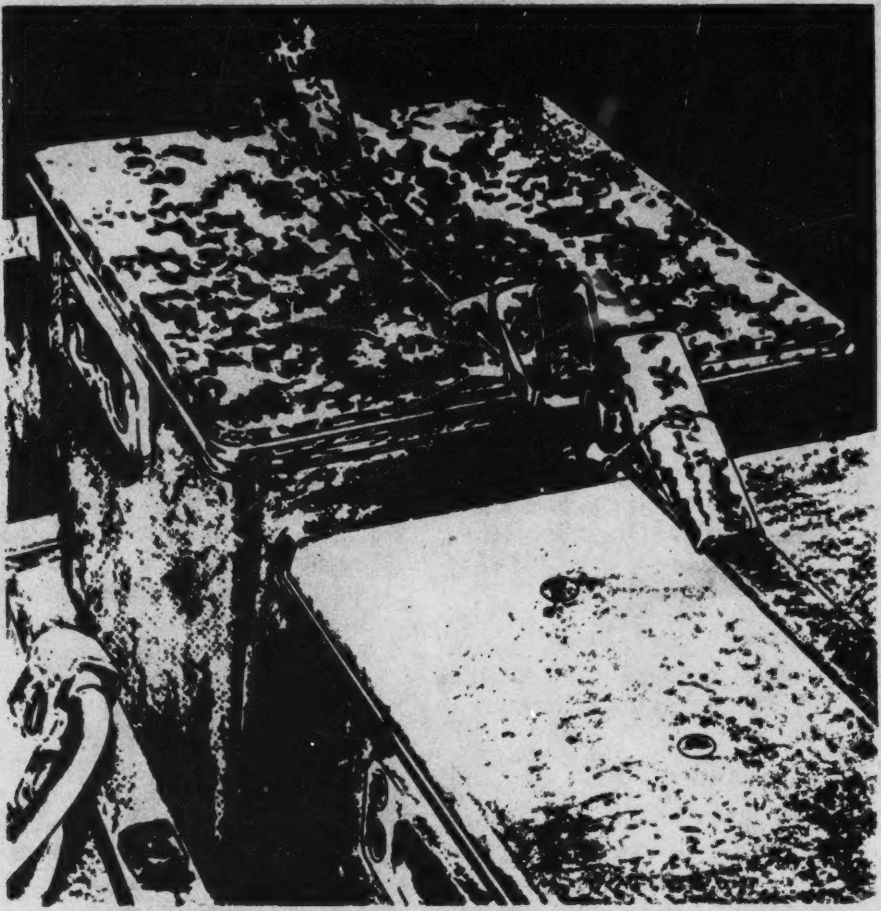
EXFOLIATION

A form of intergranular corrosion, exfoliation occurs along the elongated grains of a heavily rolled or extruded alloy. The corrosion attacks along the grain boundaries parallel to the surface resulting in a leafing action. This action causes the uncorroded layers to separate and split, ultimately producing a blister or raising leaf-like strips of metal at the surface as shown in figure 9-4. Exfoliation is also evident at the countersunk rivets where the end grains of an alloy are exposed to a corrosive environment (see figure 9-5). Sealants applied in and around fasteners help to avoid the exposure of the grain boundaries to the environment.

Exfoliation is most often seen on extruded sections where grain thicknesses are usually less than in rolled forms. A similar corrosion also occurs under plating layers such as chromium.

GALVANIC OR DISSIMILAR METALS CORROSION

Dissimilar metals corrosion, or galvanic corrosion, occurs when dissimilar metals are in contact and an external circuit is provided by the presence of moisture. It is usually recognized by the presence of a buildup of corrosion at the joint between the metals. For example, aluminum and magnesium metals riveted

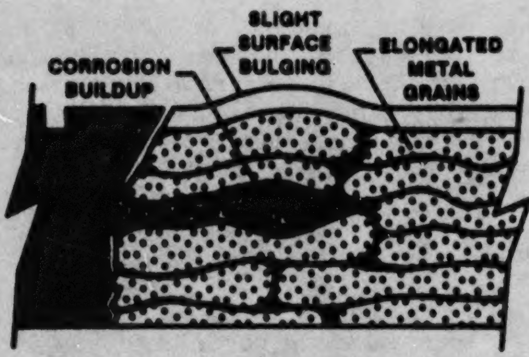


226.97

Figure 9-3.—Direct surface attack in battery compartment.

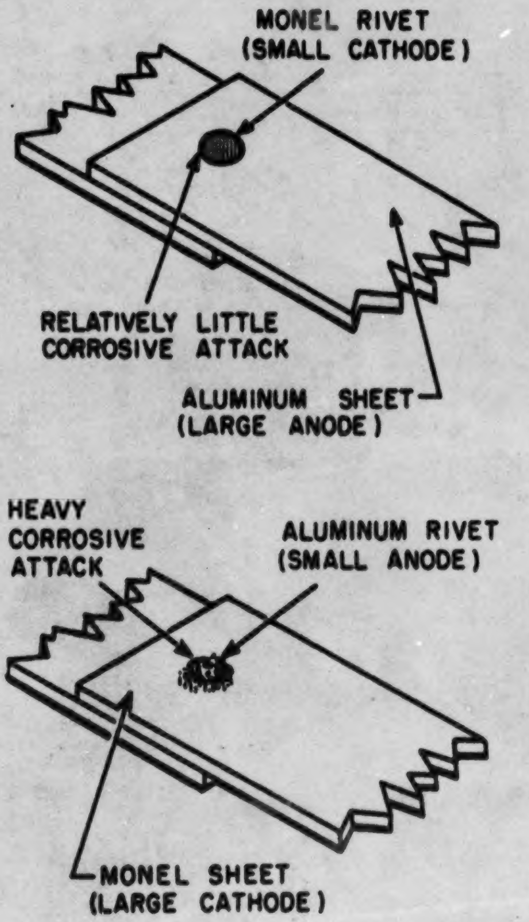
together form a galvanic couple if moisture and contamination are present. When aluminum pieces are attached with steel bolts or screws, galvanic corrosion can occur between the aluminum and the steel.

When such a condition develops, either from faulty design or from maintenance errors, the most easily oxidized surface becomes the anode and corrodes. If the more active member of the two metals is small compared to the less active member, attack will be severe and extensive when insulation breaks down. If the area of the less active metal is small compared to the other, the attack is relatively slight. (Figure 9-6 illustrates this factor.) Metals and metal alloys are corrosion prone in varying degrees. The result of this dissimilar metals coupling is an attack on the more active (anodic) of the two metals. For example, cadmium is often used as a protective coating for steel. Cadmium is more active (anodic) than steel in seawater. Therefore, when exposed to a corrosive environment, the cadmium will corrode as the anode passing electrons


SLIGHT SURFACE BULGING
CORROSION BUILDUP
ELONGATED METAL GRAINS

Exfoliation corrosion is a type of intergranular corrosion along the elongated grain boundaries of some metal alloys. This corrosion form is common in and around metal fasteners.

Figure 9-4.—Exfoliation corrosion (model).


MONEL RIVET (SMALL CATHODE)
RELATIVELY LITTLE CORROSIVE ATTACK
ALUMINUM SHEET (LARGE ANODE)
HEAVY CORROSIVE ATTACK
ALUMINUM RIVET (SMALL ANODE)
MONEL SHEET (LARGE CATHODE)

213.50

Figure 9-5.—Effects of area relationships in dissimilar metal contacts (galvanic corrosion).

to the cathodic steel. Cadmium is called "sacrificial" because it corrodes in place of the steel. Figure 9-6 helps to explain galvanic corrosion as cadmium plated steel is exposed to corrosive elements.

The other factor that determines the rate and severity of galvanic corrosion is the "distance effect," which states that galvanic corrosion of the anodic metal will be most severe at the point of contact between the dissimilar metals, and least severe where the two are separated.

Actions which prevent or minimize galvanic corrosion include:

a. Coupling metals which are electrochemically similar

b. Avoiding large cathode to small anode ratios

c. Insulating metal surfaces with nonconductive materials

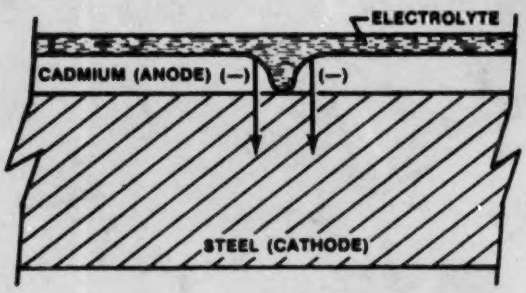
d. Using corrosion inhibitors

e. Avoiding threaded joints between dissimilar metals

f. Applying protective coatings to both metals.

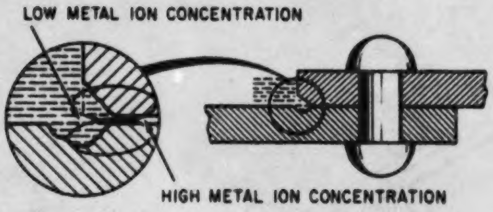
CONCENTRATION CELL CORROSION

This type corrosion sometimes called "crevice corrosion", concentration cell corrosion is an electrochemical attack caused by special environmental conditions. It occurs in localized areas where small amount of electrolyte remain for long periods without drying. Concentration cell corrosion is encountered at crevices, spot welds, lap joints, fasteners, flanged fittings, couplings, threaded joints, and tubesheet supports. Gaskets and sealing materials

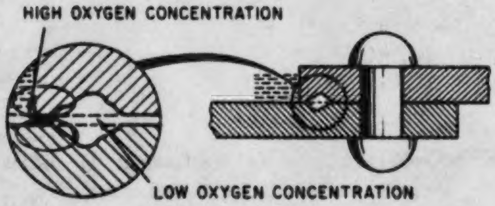

ELECTROLYTE
CADMIUM (ANODE) (—)
(—)
STEEL (CATHODE)

In a corrosive environment, galvanic corrosion involves the attraction of electrons from an active metal to a passive metal.

Figure 9-6.—Galvanic corrosion (model).


LOW METAL ION CONCENTRATION
HIGH METAL ION CONCENTRATION

METAL ION CONCENTRATION CELL RIVETED LAP JOINT


HIGH OXYGEN CONCENTRATION
LOW OXYGEN CONCENTRATION

OXYGEN CONCENTRATION CELL

213.30

Figure 9-7.—Concentration cell corrosion.

which absorb electrolyte also contribute to concentration cell corrosion. Figure 9-7 shows a common area that is prone to this type of corrosion attack.

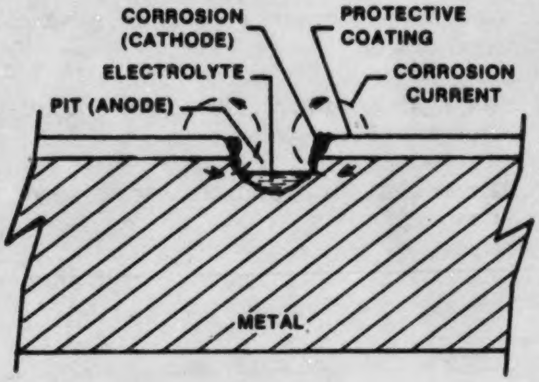
When in contact with a high oxygen bearing electrolyte, metal areas are cathodic compared to metal areas where less oxygen is present in the electrolyte. Polarization of these areas forms a "high oxygen concentration cell" which results in an attack on the anodic area. A cathodic area can also be produced where a metal contacts an electrolyte containing a quantity of metal ions. This corrosion form is called "metal ion concentration cell."

Concentration cell corrosion can be reduced by:

a. Using butt welds instead of riveted, spot-welded, and bolted joints
b. Caulking, welding, and soldering existing lap joints
c. Avoiding electrolyte-absorbing gaskets and materials
d. Periodic equipment cleaning to remove surface deposits
e. Clearing drain holes where electrolyte collects
f. Applying protective coatings.

PITTING

Pitting is one of the most destructive forms of corrosion. It is a localized type of corrosion and is characterized by deep cavities or depressions as shown in figure 9-8. Pitting is generally


CORROSION (CATHODE)
PROTECTIVE COATING
ELECTROLYTE
CORROSION CURRENT
PIT (ANODE)
METAL

Pitting is the result of a broken surface coating and the subsequent creation of an active electrochemical cell.

Figure 9-8.—Pitting (model).

associated with magnesium, aluminum alloys, steels, and stainless steels in a marine environment. Pitting occurs when the protective film or layers of corrosion products break down. On aluminum and magnesium alloys pitting corrosion is first noticeable as a white or gray powdery deposit, similar to dust, which blotches the surface. When the deposit is cleaned away, tiny pits or holes can be seen in the surface. Pitting corrosion may also occur in other types of metal alloys.

INTERGRANULAR ATTACK

This type of corrosion is localized at or in the narrow zones between the minute grains (or crystals), which make up a metallic substance. Intergranular corrosion attacks some metal alloys without significant damage to the metal grains. However, as the zones between grains (grain boundaries) deteriorate, loss of the load-bearing capability and alloy disintegration is experienced.

Welding, stress relief annealing, improper heat treating, or overheating in service cause an alloy to become susceptible to intergranular attack. These actions establish microscopic differences in the metal at the grain boundaries. For example, austenitic stainless steel normally exhibits excellent corrosion resistance. However, when thick plates are heated, as a result of welding to within a temperature range of from 425° to 790°C (800° - 1,450°F), and subsequently cooled at a slow rate, intergranular corrosion could occur if the alloy is exposed to certain corrosive environments.

Intergranular corrosion may exist without visible evidence on exterior surfaces. It develops so gradually that it is well established before becoming apparent, and serious structural weakening may occur before an appreciable volume of corrosion products accumulate on the surface.

STRESS CORROSION CRACKING

Stress corrosion cracking is the result of corrosion and sustained tensile stress. The initial step of stress corrosion cracking seems to involve the localized removal of the protective coating on many high strength alloys. Subsequently, a corrosion pit can form at this active site. The concentration of ions within the pit promotes the initial growth of corrosion. In time, the corrosion can advance to the point where applied or residual stress mechanically fractures the embrittled layer, exposing fresh alloy which can also become embrittled and fractured.

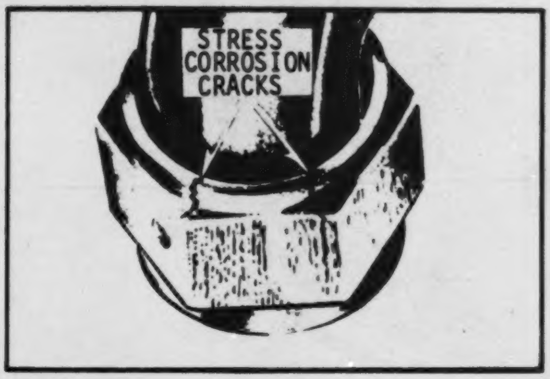
Press and shrink fits, pipe thread type fittings, clevis joints, and exposed or over-stressed tubing nuts are examples of parts susceptible to stress corrosion cracking. (Figure 9-9 shows stress corrosion cracking of an overtightened packing nut.)

FATIGUE CORROSION

This type of corrosion is the result of cyclic stress rather than sustained stress that causes stress corrosion cracking. It is caused by the combined effects of corrosion and stresses applied in cycles to a part.

An example of cyclic stress is the alternating loads to which the reciprocating rod on the piston of a hydraulic, double-acting actuating cylinder is subjected. During the extension stroke a compression load is applied and during the retracting or pulling stroke, a tensile or stretching load is applied.

Once fatigue corrosion begins, continuous flexing prevents the repair of protective surface coatings, and additional corrosion takes place in the area of stress. This is difficult to detect in



226.98

Figure 9-9.—Stress corrosion cracking.

advance, except as cracking develops. Frequently, by the time it is noticed, the only solution is replacement of the part. Fracture of a metal part due to fatigue corrosion generally occurs at a stress far below the fatigue limit in a laboratory environment, even though the amount of corrosion is unbelievably small. For this reason, protection of all parts subject to alternating stress is particularly important whenever practical, even in environments that are only mildly corrosive.

FRETTING CORROSION

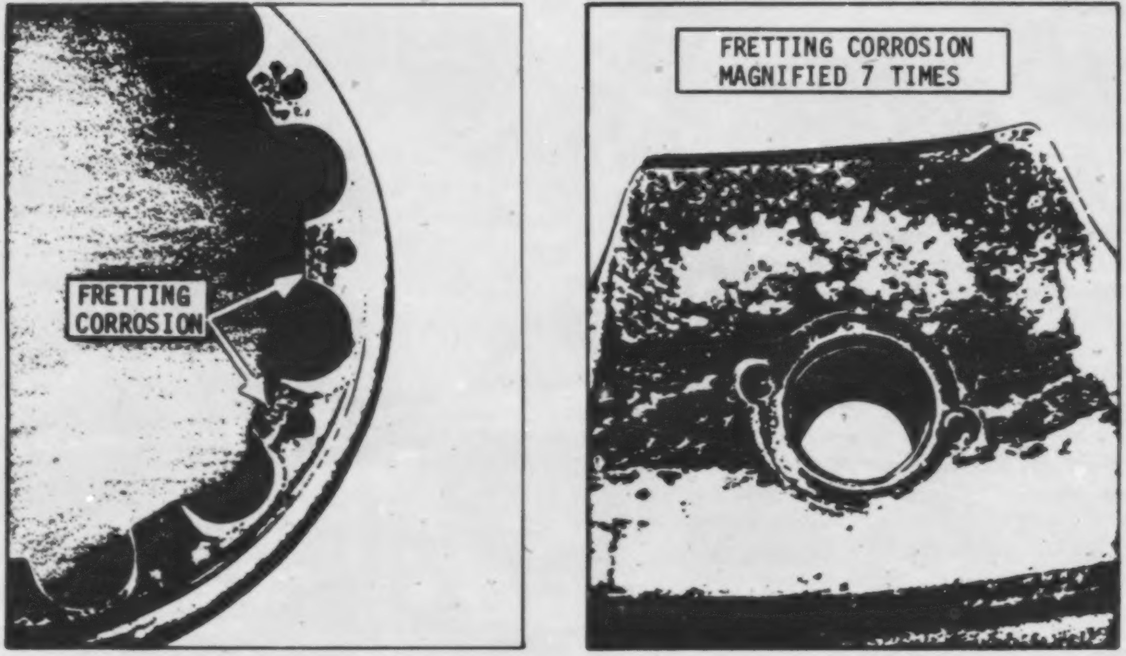
Fretting corrosion is a limited but highly damaging type of corrosion caused by a slight vibration, friction, or slippage between two contacting surfaces which are under stress and heavily loaded. It is usually associated with machined parts, such as the area of contact of bearing surfaces, two mating surfaces, and bolted or riveted assemblies. At least one of the surfaces must be metal.

In fretting corrosion, the slipping movement destroys the protective films that may be present on the metallic surface. This action removes fine particles of the basic metal. The particles oxidize and form abrasive materials which further agitate within a confined area to produce deep pits. Such pits are usually so located as to increase the fatigue potential of the metal.

Figure 9-10 shows an example of fretting corrosion. This type of corrosion is evidenced at an early stage by surface discoloration and by the presence of corrosion products in any lubrication present. Lubrication, adding protective bushings, and securing the parts so that they are rigid are the most effective measures to prevent this type of corrosion.

CORROSION IN ELECTRICAL EQUIPMENT

While corrosion damages machinery by weakening the structures it attacks, it produces a



226.99

Figure 9-10.—Fretting corrosion.

greater variety of damage in electrical components. Corrosion can cause increased resistance and it can cause open circuits by eating through conductors or placing insulative deposits between connecting components. It can break down electronic components and cause jamming or structural failure of moving parts in circuits. Corrosion products can cause short circuits, and corrosion processes can destroy insulation. The presence of batteries also means potential corrosion from acid fumes, exudinate, and electrolytes.

CORROSION IN ELECTRICAL CIRCUITS

Electrical circuits and components are subject to most of the normal causes of corrosion and some other causes unique to the nature of their construction. To begin with, they contain a variety of dissimilar metals and materials. Their parts are small, and once corrosion starts it can quickly cause damage. Slightly corrosive situations that would not bother machinery can destroy delicate electrical and electronic components.

Microbial, or microbiological attack threatens electrical equipment more than it does machinery. Most circuits are protected from normal weather by enclosures and special coatings such as potting compounds. However bacteria and fungus can penetrate many types of barriers, and once the necessary temperature, humidity, and organic material on which to feed are present, these organisms multiply. Fungus breaks down organic components such as seals of rubber or plastic, and insulations of many types. It also attacks varnishes and many types of plastic. Bacteria feeds on a wide variety of natural and synthetic paints and plastics, and in so doing generates sulfuric and nitric acid wastes which attack metal.

Another threat to electric and electronic components is the presence of potentially corrosive compounds you may expose them to in the process of cleaning and preserving nearby surfaces. The pickling or chemical conversion coat materials are corrosive to many metals and care must be taken to keep them away from electrical components. When they are rinsed away you must be careful that they do not accumulate in an undesirable location. Some solvents and cleaners will soften plastics and paints, so you must use only the types authorized.

Other substances can damage electrical equipment when used in the wrong place or in the wrong way. For instance, silicone sealant gives off acetic acid fumes when it is curing. PVC produces acid fumes at high temperature. Diester oils soften paint. Molybdenum disulfide can break down to sulfuric acid when heated in the presence of water. Fluorocarbons such as refrigerants can become corrosive when combined with water, as can some hydraulic fluids. Even graphite, used as a dry film lubricant, is cathodic with some metals. To ensure that incompatible substances are not combined or that substances are not used in the wrong environment, the Navy has prepared many guidelines and specifications that you must be aware of and follow.

CORROSION PREVENTION

Equipment being built for the Navy is preserved against corrosion to the greatest extent possible. A good coat of paint or protective plating is the primary protection on immovable parts, while moving parts may have preservatives or lubricants on them. By using routine procedures to keep the original protection in good condition and to maintain protective films where needed, you can keep your equipment free of any significant corrosion for a long time.

Even the most difficult corrosion problems can be prevented. The intensity of a program varies to meet the severe environment of shipboard operations, and the relatively mild conditions of an inland shore base.

Preventive maintenance, as related to corrosion control, includes the following specific functions:

1. An adequate cleaning program
2. Periodic lubrication and application of protective films such as wax and protective greases
3. Detailed inspection for corrosion and failure of protective systems

4. Preservation of clean, dry, corrosion-free surfaces including early removal of corrosion products as they occur
5. Early paint touchup of damaged areas

A successful corrosion preventive maintenance program reduces the time you spend repairing corrosion damage and reduces the number of maintenance actions required to repair corrosion. This in turn increases reliability and the longevity of GSE.

PREVENTIVE MAINTENANCE SCHEDULE

The OPNAVINST 4790.2 series requires that GSE shops establish a maintenance schedule for each item of equipment. The GSE Subcustody and Periodic Maintenance Record OPNAV 4790/50, GSE Custody and Maintenance Record OPNAV 4790/51, and GSE Daily Record OPNAV 4790/52 are all used to schedule and record all corrosion maintenance actions.

CLEANING

General cleaning (washing) of equipment helps prevent the accumulation of dirt, oil, water, fluids, salt, and other contaminants that cause corrosion on GSE. When cleaning GSE you should use the mildest cleaning method that will remove the contaminants. That is, if a tow tractor is to be washed and it is only dusty, you would wash it with a solution of one part MIL-C-43616 cleaning compound and nine parts of water using a sponge. If the tow tractor is covered with salt spray, you would use a solution of one part cleaning compound to about four parts of water using a scrub brush and cleaning pad. Cleaning the equipment removes one of the four conditions that must be present for the corrosion process—the electrolyte.

INSPECTION

After cleaning, the next step in corrosion preventive maintenance is a good detailed visual inspection. During the inspection you should check the corrosion-prone areas looking closely for corrosion in its initial stages. If you find any corrosion, report it to your supervisor for proper documentation. Corrective action must be taken at this time to avoid costly repairs later.

LUBRICATION

After your cleaning and inspection, GSE must be lubricated in accordance with the applicable Maintenance Instruction Manual (MIM). All hinges, latches, etc., must be sprayed with corrosion preventive compound MIL-C-81309 which displaces water and leaves an ultra thin protective coating. You should oil with lubricating oil VV-L-800. This prevents corrosion and ensures proper operation of the hinges, latches, etc.

PRESERVATION

Preservation of clean, corrosion-free equipment surfaces is part of the process of readying equipment for storage for extended periods. After cleaning and inspecting the equipment to be stored, you must preserve any surface that has its protective coating damaged. It may be repainted at this time but first any corrosion must be removed. If the equipment is not painted, the corrosion must be removed and some other form of protective film applied.

REPAIR OF CORRODED SURFACES

Once corrosion occurs, the defective protective material and corrosion products must be removed until clean metal is uncovered. The metal surface must then be given a new, effective, anticorrosion coating. If corrosion was produced by causes such as the presence of dissimilar metals, these causes must also be dealt with.

CORROSION REMOVAL AND SURFACE PREPARATION

The following surface preparations represent both mechanical and chemical paint and corrosion removal methods. They are listed from the most effective or preferred to the least effective or not preferred. Each GSE maintenance station is responsible for developing the proper procedures for operating surface preparation equipment in accordance with applicable MIMs.

The key to achieving a successful, long-lasting coating system lies in good adhesion between coating and metallic surface. Paint does not adhere to a surface which is poorly prepared. Dirt, oil, grease, corrosion by-products, moisture, and other contaminants prevent complete contact between paint and base metal. In addition a metallic surface must be roughened to enable the paint system to adhere to the surface. This roughened or anchor pattern can be produced by mechanical means or by chemical etchings.

You should remove corrosion, scale, and old paint by the least destructive method. Where simple touch-up painting is required, it may be necessary to feather the edges of existing sound paint with light sanding to provide an adequate anchor for the touch-up paint.

It is important that the initial paint be applied as soon as possible following surface preparation. A prolonged lapse in time between surface preparation and painting contributes to the formation of minute corrosion on the prepared surface and subsequent coating system failure.

Removing Dirt, Oil, and Grease

The first step in surface preparation is the removal of dirt, salt, lubricants, hydraulic oil, and other surface contaminants. Grease and oil that are present during abrasive blasting, grinding, or wire-brushing tend to spread out over the treated surface and disrupt the coating bond. The cleaning method that you use is dependent upon the type of soil, its extent, and the available cleaning equipment. Detergent cleaning, solvent cleaning, alkaline cleaning, emulsifiable solvent cleaning, steam cleaning, and acid cleaning are several of the popular cleaning/degreasing methods.

SOLVENT CLEANING.—Detergents and solvents are highly effective in attacking and dissolving grease and oil on metal surfaces. Most solvents can be either applied in vapor degreasing equipment or by wiping. Solvents are specially useful for cleaning small parts and spot cleaning jobs. Some disadvantages to the use of degreasers lie in their toxicity and flammability. Many solvents are particularly dangerous when used on oxygen service equipment.

ALKALINE CLEANING.—Alkaline cleaning is an effective and relatively inexpensive method for removing soil and grease. It can be applied by brushing or wiping, soak tank cleaning, and pressure spray cleaning. Alkaline cleaners readily remove oil, grease, and other soils and do not emit toxic fumes. It should be noted that aluminum is attacked by highly alkaline cleaning compounds.

SOLVENT EMULSION CLEANING.—Emulsifiable solvent cleaning is an effective cleaning method for removing heavy oil, grease, wax, and other contaminants.

ALKALINE STEAM CLEANING.—Both portable and stationary steam cleaners are effective in removing soil from large equipment. Alkaline steam cleaning is usually an expensive method for cleaning and leaves an alkaline residue which must be rinsed.

ACID CLEANING.—Acid cleaning combines the forces of oil solvents and detergent cleaners in removing grease, oil, light rust, and other contaminants. The method is useful on heavy steel structures where surface etching is required. This cleaning method requires a thorough rinse with clean water.

Mechanical Corrosion Removal

Abrasive blasting is the preferred surface preparation method for many of the components of ground support equipment. Wet abrasive blasting is preferred to dry. Before blasting, however, it is important to disassemble the components in accordance with the applicable technical manual. Mask all areas that should not be blasted such as tapped holes, key ways, machined surfaces, reflectors, lights, and gages with suitable masking material.

When using abrasive blasting equipment, you must wear the proper protective clothing, face shield, and breathing devices.

Table 9-3.—Recommended grit for steel and aluminum

TYPE OF METAL BLASTED	RECYCLING			NON-RECYCLING		
	GRIT	SAE MESH	PRES PSI	GRIT	SAE MESH	PRES PSI
Steel	Angular Silica Sand	20/40	75	Silica Sand	20/40	75
				Crushed Garnet	20/40	75
	Crushed Garnet	20/40	75			
	Aluminum Oxide	20/50	50			
Aluminum	Silica Sand	20/40	75	Silica Sand	20/40	75
	Aluminum Oxide	20/50	50	Crushed Garnet	20/40	75
	Crushed Garnet	20/40	75			

DRY ABRASIVE BLASTING.—Abrasive or grit blasting is the best method for obtaining the clean anchor pattern necessary for most coating systems. The process involves propelling abrasive particles against the metallic surface by either high pressure air or spinning paddle wheel. The impingement (striking) of these particles against the metal abrades away deteriorated paint and scale. Many abrasive blast machines (portable dry honing machine) reclaim used grit by cleaning and sifting out dirt, scale, and damaged grit. Grit that has been recycled after use on steel, brass, bronze, or copper-nickel shall not be used on aluminum. Do not blast aluminum with steel or copper slag or chilled iron grit.

Table 9-3 lists some common abrasive materials and grit sizes.

The portable dry honing machine was discussed in Chapter 6.

WET ABRASIVE BLASTING.—Wet abrasive blasting is preferred to dry. Water blasting is a relatively new technique which requires high-pressure producing equipment. The water blast method removes surface chemical contaminants, deteriorated paint, grease accumulations, oil, and mastic materials. Note: You must use Sodium Nitrite MIL-S-24521, during the abrasive process to prevent flash rusting. Figure 9-11 is a Portable Hydroblaster, Model 610E. The Hydroblaster or other WATER blast machines can be dangerous if not handled properly or with sufficient safeguards. When operating these machines, personnel shall wear a respirator, safety goggles and protective clothing.

Cleaning Surfaces with Power Tools

Power tool cleaning includes devices which impact the metallic surface with an abrasive substance or mechanical object. Impact tools. powered wire brushes, and disk sanders are some of the common power tool cleaners.

IMPACT TOOLS.—Impact tools such as the needle gun (pneumatic descaler) provide a rapid means for removing rust and old paint from metal surfaces. These tools must never be used on aluminum.

POWERED WIRE BRUSHES.—A wire brush powered pneumatically or by electric motor is an effective method for removing small amounts of paint and rust. Often, the overextended use of a wire brush results in a metal surface that is polished to a glossy-like

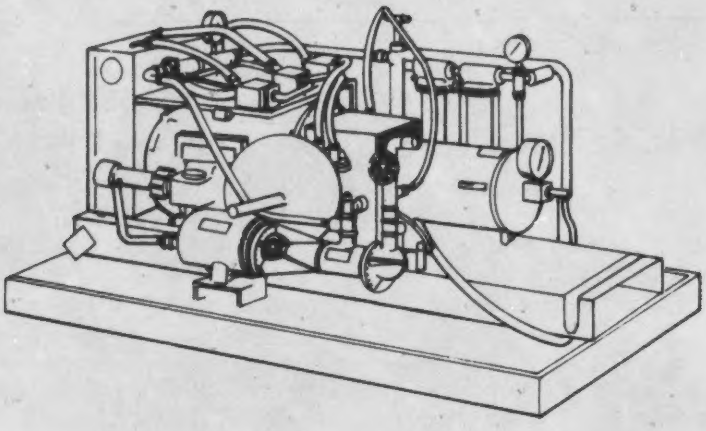


Figure 9-11.—Portable hydroblaster, Model 610E.

appearance. This type of surface produces a poor anchor pattern for paint adhesion.

DISK SANDERS.—Usually electric or pneumatic, disk sanders abrade the metal surface with coarse to fine grit. When used in conjunction with the needle gun, the disk sander can produce a uniform anchor pattern of very closely spaced scratches.

When using abrasive power hand tools, you must wear eye protection to prevent serious injury.

Hand Cleaning

Hand cleaning is the most ineffective method for removing corrosion by-products and old paint. The use of hand tools should be limited to instances where power-operated equipment is not available, where power tools are too large to clean tight surfaces, or where parts are too small or precise to withstand power cleaning. Hand tools include wire brushes, scrapers, abrasive mats and aluminum oxide paper. The nature of some surfaces, such as chrome shift levers or hydraulic piston rods, limit the use of many highly abrasive surface preparation techniques. The light corrosion products found on these surfaces can be removed by a cleaning solvent such as P-D-680 applied with No. 320 aluminum oxide paper.

Chemical Cleaning Methods

Paint removers and acid metal cleaners are also effective in removing old paint and some corrosion products.

PAINT REMOVER.—Chemical paint removers such as epoxy remover MIL-R-81294, breaks down and softens most existing paints. Chemical paint removers are toxic, contain ingredients harmful to both skin and eyes, and must be used with care. A face shield or goggles, rubber gloves, and coveralls shall be worn when a can of paint remover is opened. The can must be held away from the face and body. If the paint remover gets on your skin, immediately wash with large quantities of fresh water and soap. Freely rinse the affected area with diluted Isopropyl Alcohol, TT-I-735A (use one part Isopropyl Alcohol to four parts water) and follow with further water washing. SPEED IN REMOVING PAINT REMOVER IS VERY IMPORTANT. Do not apply salves or ointments. Obtain medical aid. If paint remover gets into your eyes, flood with large quantities of fresh water and obtain medical aid immediately.

METAL CONDITIONER.—When applied to steel surfaces, metal conditioning compounds loosen, disintegrate, or affect rust in such a manner that it may be readily removed. A metal conditioner MIL-M-10578, is capable of etching the metal surfaces to provide a good surface for painting.

COATING SYSTEMS

This section covers the coatings and coating systems applicable to GSE. Several approved coating systems and procedures are used for corrosion preventive touch-up and total rework operations.

For GSE, most metal components are constructed of mild steel or aluminum. The coatings described are compatible to these metals.

A complete coating system usually consists of the following three parts:

1. Chemical conversion coating
2. Primer
3. Finish coating

The following list of three coating systems are detailed in NAVAIR 17-1-125. The three in order of the most desirable are:

1. Chemical conversion—Epoxy—Polyurethane
2. Chemical conversion—Epoxy—Polyamide
3. Chemical conversion—Epoxy—Acrylic Nitrocellulose

CHEMICAL CONVERSION COATING

A chemical conversion coating is formed by the interaction of a chemical compound with the base metal. Steel surfaces are typically treated with a phosphate base compound. Oxides, chromates, phosphates, and combinations thereof are other typical chemical conversion coatings. The result of this chemical interaction is a film that is both water insoluble and corrosion resistant. Some of these coating adhere tightly to the surface; others depend on the primer to bond them. A chemical conversion coating is an excellent base for subsequent organic coatings.

Chemical Conversion Coatings for Steel

Steel components shall be pretreated with a phosphoric acid base compound, MIL-M-10578. This compound removes corrosion and conditions steel surfaces in preparation for the application of a coating system. A slight etching action is produced to promote the adhesion of subsequent paint or corrosion preventives.

Chemical Conversion Coatings for Aluminum

Aluminum is a highly active metal in a corrosive environment. However, its primary conversion coating is a protective oxide layer that produces a very effective surface and resists corrosion in an aggressive environment. The chromate base coat, MIL-C-81706 is sprayed or wiped on clean metal until it turns yellow or golden. The surface is then rinsed well and allowed to air dry. These coatings are not strong until the primer is applied over them so treated surfaces must be handled carefully.

PRIMERS

The primer controls or interferes with the formation of corrosion on the base metal. The primer coat also provides a compatible adhesion layer between the finish coat and the metal surface. In accomplishing these functions, primers are classified in three categories: sacrificials, barrier, and corrosion-inhibitor.

Sacrificial

These primers employ large quantities of metallic powders, usually zinc, in a vehicle which hardens, forming the prime coat. The metallic powders corrode in place of the base metal.

Barrier

These primers seal the base metal from potential corroding environments. Barrier primers generally offer low water permeability and high resistance to chemical degradation. Barrier primer formulas are often of the same or similar type as the finish coat. For example, epoxy primers are used with epoxy finish coats. However, a few primers, such as epoxy, are compatible with a number of finish coatings.

Corrosion-Inhibitor

Use corrosion-inhibiting compounds to control corrosion at the base metal. These soluble compounds react with moisture to inhibit corrosion. This broad category of primers includes chromate chemicals, zinc-oxide, and zinc molybdate.

The primers specified for ground support equipment are of the barrier type. One is an epoxy and the other an epoxy polyamide. Both bond very well to the prepared metal surface and provide a good surface for the finish coat.

In the past, the common primer for ground support equipment has been zinc chromate, which can either be brushed or sprayed on. This is a good sacrificial and barrier type primer when used under a conventional enamel finish coat. However, this finish coat is not one of the recommended coatings for GSE.

Epoxy polyamide primer is considered superior for ground support equipment. It provides an excellent barrier and base for epoxy, acrylic, and polyurethane finish coats.

Epoxy polyamide is supplied in "two part" kits, consisting of a resin compound, called "Component I" and a hardener, called "Component II." When preparing the primer, always pour Component II, the hardener, into Component I, while constantly stirring.

After the two parts are mixed, they are thinned to the correct consistency for spraying, and allowed to set up for half an hour to allow their chemical action to begin.

The new epoxy-type primers and finishes contain and give off dangerous chemical gases and vapors. They can be used by qualified personnel approved by the medical department using proper safety equipment in properly prepared working spaces.

FINISH COATINGS

The two primary functions of the finish coating or topcoat are undercoat protection and visual appeal. This type of coating compound acts to shield underlying coats of pretreatment and primer from sun, rain, windblown matter, and chemical pollutants. The finish coat also provides color and decoration to the surface it protects. As with primers, finish coats consist of a color pigment formulated to provide exposure resistance.

There are two kinds of finish coatings. They are: "single component" and "two-part" systems. The "single component" is packaged as a complete coating compound and is air cured. The "two part" system is usually supplied in a kit form composed of an acid and a resin compound. "Two part" systems are catalytically cured and therefore have a limited pot life. They must be applied within a specific time interval after mixing.

Regardless of the type of finish coat, strict adherence to the manufacturer's directions is essential for optimum coating performance. Further, the type of finish coating must be compatible with the primer or intermediate coating over which it is applied. Most finish coating compounds are applied in two coats. The first is a thin coat which is allowed to stand for a short period followed by a heavy coat to obtain the specified dry film thickness.

When facilities are available, the three finish coat materials that are best for ground support equipment are polyurethane, epoxy polyamide, and acrylic nitrocellulose.

Polyurethane is a two-part paint, and gives the best surface when the equipment is being entirely recoated. It is perhaps the most difficult of the three to apply because of the toxic nature of the sprayed paint, and its flammability. It can only be used in well ventilated areas where there are no open flames or sparks. When polyurethane paints and compounds are in a liquid state they give off isocyanate vapors which are a health hazard. Before you mix or apply this type of paint you must pass a special physical exam and be certified as having no respiratory problems or sensitivity to isocyanates. Whoever works with polyurethane must wear special protective equipment to avoid breathing or coming in contact with the vapor.

If you work with or are in the area of polyurethanes you must also have an annual or semiannual medical check to ensure your continued good health.

Epoxy-polyamide is another two-part paint which provides an excellent coat, but which may become chalky after long exposure to strong sun and other adverse weather conditions.

Acrylic nitrocellulose is a single component lacquer which is recommended for touching up and applying markings. It is thinned for spraying, and as with the other sprayed paints currently used, presents a fire or explosive hazard.

GROUND SUPPORT EQUIPMENT CLEANING AND CORROSION CONTROL, NAVAIR 17-1-125

The current technical manual to be used in the prevention, detection, and repair of corrosion on ground support equipment is *Ground Support Equipment Cleaning and Corrosion Control*, NAVAIR 17-1-125. This publication takes precedence over any and all maintenance instruction manuals (MIMs) and service instruction manuals (SIMs) at both the organizational and intermediate level maintenance activities for methods of prevention, detection, and repair of corrosion. You still follow the maintenance and service manuals in conjunction with matters not pertaining to corrosion control.

You will find the *Ground Support Equipment Corrosion Control*, NAVAIR 17-1-125 very helpful because it spells out specifically which materials and procedures you are to use to clean up corrosion and restore the protective surface.

Once an inspection for corrosion is scheduled by the Planned Maintenance System, you refer to the appropriate Maintenance Requirements Card and to Section VI of *Ground Support Equipment Corrosion Control*, NAVAIR 17-1-125 manual. In Section VI, representative types of equipment are pictured, with the areas prone to corrosion indicated. (See figure 9-12A, foldout at the end of this chapter.)

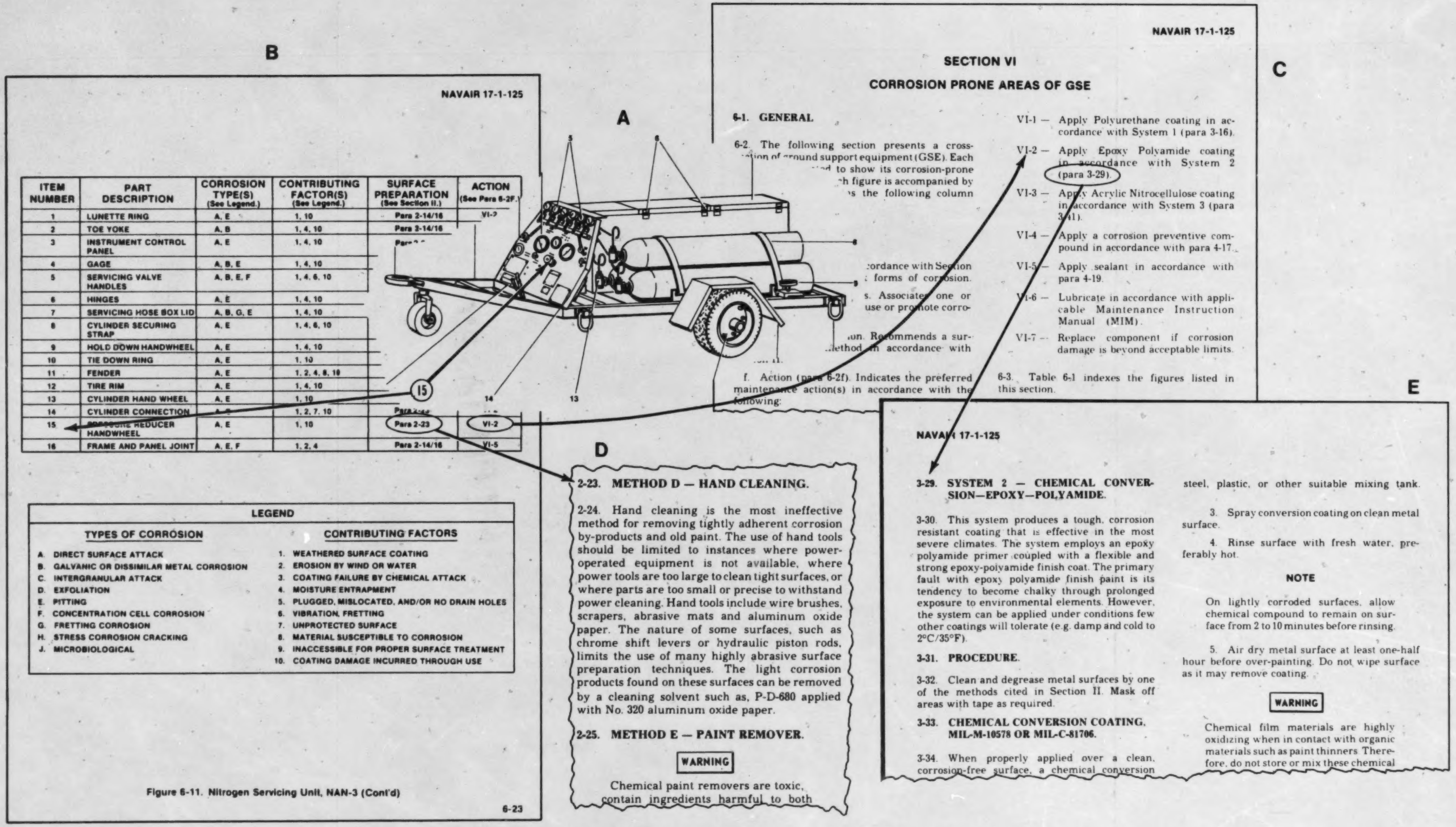
A table (figure 9-12B, foldout at the end of this chapter) that accompanies the picture of the equipment tells you what type of corrosion to look for at each point, its probable causes, and what to do about it.

If you find corrosion at any of the indicated points, go to the paragraphs referenced in the table to find the specific methods for removing the corrosion products and recoating the surface.

For instance, in figure 9-12A (foldout at the end of this chapter), if you find corrosion at location 15 (the pressure reducing handwheel of the nitrogen servicing unit) you proceed as follows:

The table in figure 9-12B (foldout at the end of this chapter) refers you to paragraph 2-23 of the manual for the means of surface preparation. As you can see in figure 9-12C (foldout at the end of this chapter), the method to use is hand cleaning, and it is described under paragraph 2-23.

A list of maintenance actions is provided in the beginning of Section VI, and is reproduced in figure 9-12D (foldout at the end of this chapter). After cleaning the handwheel, you are directed to take action VI-2, which is to apply an epoxy-polyamide coating. The procedures for applying this coating are described beginning with paragraph 3-29 of the Corrosion Control Manual, reproduced in figure 9-12E (foldout at the end of this chapter).


A
B
C
D
E
5
6
8
9
13
14
15

NAVAIR 17-1-125

ITEM NUMBER	PART DESCRIPTION	CORROSION TYPE(S) (See Legend.)	CONTRIBUTING FACTOR(S) (See Legend.)	SURFACE PREPARATION (See Section II.)	ACTION (See Para 6-2F.)
1	LUNETTE RING	A, E	1, 10	Para 2-14/16	VI-2
2	TOE YOKE	A, B	1, 4, 10	Para 2-14/16	
3	INSTRUMENT CONTROL PANEL	A, E	1, 4, 10	Para	
4	GAGE	A, B, E	1, 4, 10		
5	SERVICING VALVE HANDLES	A, B, E, F	1, 4, 6, 10		
6	HINGES	A, E	1, 4, 10		
7	SERVICING HOSE BOX LID	A, B, G, E	1, 4, 10		
8	CYLINDER SECURING STRAP	A, E	1, 4, 6, 10		
9	HOLD DOWN HANDWHEEL	A, E	1, 4, 10		
10	TIE DOWN RING	A, E	1, 10		
11	FENDER	A, E	1, 2, 4, 8, 10		
12	TIRE RIM	A, E	1, 4, 10		
13	CYLINDER HAND WHEEL	A, E	1, 10		
14	CYLINDER CONNECTION	A, E	1, 2, 7, 10	Para 2-	
15	PRESSURE REDUCER HANDWHEEL	A, E	1, 10	Para 2-23	VI-2
16	FRAME AND PANEL JOINT	A, E, F	1, 2, 4	Para 2-14/16	VI-5

LEGEND

TYPES OF CORROSION

- A. DIRECT SURFACE ATTACK
- B. GALVANIC OR DISSIMILAR METAL CORROSION
- C. INTERGRANULAR ATTACK
- D. EXFOLIATION
- E. PITTING
- F. CONCENTRATION CELL CORROSION
- G. FRETTING CORROSION
- H. STRESS CORROSION CRACKING
- J. MICROBIOLOGICAL

CONTRIBUTING FACTORS

1. WEATHERED SURFACE COATING
2. EROSION BY WIND OR WATER
3. COATING FAILURE BY CHEMICAL ATTACK
4. MOISTURE ENTRAPMENT
5. PLUGGED, MISLOCATED, AND/OR NO DRAIN HOLES
6. VIBRATION, FRETTING
7. UNPROTECTED SURFACE
8. MATERIAL SUSCEPTIBLE TO CORROSION
9. INACCESSIBLE FOR PROPER SURFACE TREATMENT
10. COATING DAMAGE INCURRED THROUGH USE

Figure 6-11. Nitrogen Servicing Unit, NAN-3 (Cont'd)

6-23

NAVAIR 17-1-125

SECTION VI

CORROSION PRONE AREAS OF GSE

6-1. GENERAL

6-2. The following section presents a cross-ction of ground support equipment (GSE). Each ed to show its corrosion-prone h figure is accompanied by s the following column

cordance with Section forms of corrosion.

s. Associates one or use or promote corro-

ion. Recommends a sur- ethod in accordance with

f. Action (para 6-2f). Indicates the preferred maintenance action(s) in accordance with the following:

VI-1 — Apply Polyurethane coating in accordance with System 1 (para 3-16).

VI-2 — Apply Epoxy Polyamide coating in accordance with System 2 (para 3-29).

VI-3 — Apply Acrylic Nitrocellulose coating in accordance with System 3 (para 3-41).

VI-4 — Apply a corrosion preventive compound in accordance with para 4-17.

VI-5 — Apply sealant in accordance with para 4-19.

VI-6 — Lubricate in accordance with applicable Maintenance Instruction Manual (MIM).

VI-7 — Replace component if corrosion damage is beyond acceptable limits.

6-3. Table 6-1 indexes the figures listed in this section.

2-23. METHOD D — HAND CLEANING.

2-24. Hand cleaning is the most ineffective method for removing tightly adherent corrosion by-products and old paint. The use of hand tools should be limited to instances where power-operated equipment is not available, where power tools are too large to clean tight surfaces, or where parts are too small or precise to withstand power cleaning. Hand tools include wire brushes, scrapers, abrasive mats and aluminum oxide paper. The nature of some surfaces, such as chrome shift levers or hydraulic piston rods, limits the use of many highly abrasive surface preparation techniques. The light corrosion products found on these surfaces can be removed by a cleaning solvent such as, P-D-680 applied with No. 320 aluminum oxide paper.

2-25. METHOD E — PAINT REMOVER.

WARNING

Chemical paint removers are toxic, contain ingredients harmful to both

---

NAVAIR 17-1-125

3-29. SYSTEM 2 — CHEMICAL CONVERSION—EPOXY—POLYAMIDE.

3-30. This system produces a tough, corrosion resistant coating that is effective in the most severe climates. The system employs an epoxy polyamide primer coupled with a flexible and strong epoxy-polyamide finish coat. The primary fault with epoxy polyamide finish paint is its tendency to become chalky through prolonged exposure to environmental elements. However, the system can be applied under conditions few other coatings will tolerate (e.g. damp and cold to 2°C/35°F).

3-31. PROCEDURE.

3-32. Clean and degrease metal surfaces by one of the methods cited in Section II. Mask off areas with tape as required.

3-33. CHEMICAL CONVERSION COATING, MIL-M-10578 OR MIL-C-81706.

3-34. When properly applied over a clean, corrosion-free surface, a chemical conversion

steel, plastic, or other suitable mixing tank.

3. Spray conversion coating on clean metal surface.

4. Rinse surface with fresh water, preferably hot.

NOTE

On lightly corroded surfaces, allow chemical compound to remain on surface from 2 to 10 minutes before rinsing.

5. Air dry metal surface at least one-half hour before over-painting. Do not wipe surface as it may remove coating.

WARNING

Chemical film materials are highly oxidizing when in contact with organic materials such as paint thinners. Therefore, do not store or mix these chemical

227.120

Figure 9-12.—Inspection and correction of corrosion (A, B, C, D, and E).

APPENDIX I

ACRONYMS

The acronyms listed here are some of those that you as an AS will most often use. For a more complete list consult Appendix A OPNAVINST 4790.2B Vol. I and III.

AAR—Aircraft Accident Report

ABO—Aviators Breathing Oxygen

A/C—Aircraft

ACC—Aircraft Controlling Custodian

ACCB—Aircraft Change Control Board

ACFT—Aircraft

ACO—Administrative Contracting Officer

ACR—Allowance Change Request

ADC—Aero Space Defense Command

ADMRL—Application Data For Material Readiness List

ADP—Automatic Data Processing

ADPE—Automatic Data Processing Equipment

ADPS—Automatic Data Processing System

ADR—Aircraft Discrepancy Report

ADS—Automatic Data System

AECL—Aircraft Equipment Configuration List

AEL—Allowance Equipage List

AESR—Aeronautical Equipment Service Record

AF—Air Force

AFM—Aviation Fleet Maintenance

AFREP—Aviation Supply Office Field

AIG—Address Indicator Group

AIMD—Aircraft Intermediate Maintenance Department

AIMI—Aircraft Intermediate Maintenance Improvement Program

ALC—Air Logistics Center

ALF—Auxiliary Landing Field

AMMRL—Aircraft Maintenance and Material Readiness List

AMO—Aircraft Maintenance Officer

AMO—Aviation Material Office (Norfolk, San Diego)

AMSE—Aircraft Maintenance Support Equipment

AMSU—Aeronautical Material Screening Unit

AMSU—Aircraft Maintenance Support Unit

AMU—Aviation Monitoring Unit

AN—Army-Navy Standard

A/N—Alpha-numeric

APA—Appropriations Purchase Account

APL—Allowance Parts List

APML—Assistant Program Manager for Logistics

APN—Aircraft Procurement, Navy

APP—Advance Procurement Plan

AR—Aircraft Requirement

ARA—Assigned Responsible Agency

ARP—Analytical Rework Program

ARR—Allowance Requirements Register

ASA—American Standards Association

ASAP—As Soon As Possible

ASD—Activity Support Date

ASO—Aviation Supply Office

ASPR—Armed Services Procurement Regulations

ASSY—Assembly

ASU—Administrative Screening Unit

ASW—Anti-Submarine Warfare

A/T—Action Taken

ATE—Automatic Test Equipment

AUTOVON—Automatic Voice Network

AVC—Avionics Change

AVCAL—Aviation Consolidated Allowance List

AVCAS—Aviation Configuration Accounting System

AWM—Awaiting Maintenance

AWP—Awaiting Parts

AWPU—Awaiting Parts Unit

BCM—Beyond Capability of Maintenance

BMEP—Brake Mean Effective Pressure

B/N—Bombing/Navigation

BO—Back Order

BUNO—Bureau Number

BUPERS—Bureau of Personnel

BU/SER No.—Bureau/Serial Number

C—Cancelled

CAD—Cartridge Actuated Device

CAG—Carrier Air Group

CANTRAC—Catalog of Navy Training Courses

CASREP—Casualty Summary Reports

CAT—Catapult Shots

CCS—Check Crew Supervisor

CCS—Component Control Section

CCU—Component Control Unit

CD—Collateral Duty

CDI—Collateral Duty Inspector

CDQAR—Collateral Duty Quality Assurance Representative

CDRL—Contract Data Requirements List

C/E—Components and Equipment

CEC—Change Entry Certification

CER—Complete Engine Repair

CERRC—Complete Engine Repair Requirement Card

CETS—Contractor Engineering and Technical Services

CFA—Cognizant Field Activity

CGSE—Common Ground Support Equipment

CGSEL—Consolidated Ground Support Equipment List

CHERPT—Cherry Point

CHNAVMAT—Chief of Naval Material

CHNAVPERS—Chief of Naval Personnel

CI—Configuration Item

CINC—Commander-in-Chief

CINCLANT/PAC—Commander in Chief, Atlantic/Pacific

CINCLANT/PACFLT—Commander in Chief, Atlantic Pacific Fleet

CLAMP—Closed Loop Aeronautical Management Program

CNATRA—Chief of Naval Air Training

CNAVRES—Chief of Naval Reserve

CNET—Chief of Naval Education and Training

CNM—Chief of Naval Material

CNO—Chief of Naval Operations

CO—Commanding Officer

COD—Carrier Onboard Delivery

COMFAIR—Commander, Fleet Air

COMFAIRMED—Commander Fleet Air Mediterranean

COMFAIRWESTPAC—Commander Fleet Air Western Pacific

COMNALC—Commander, Naval Aviation Logistics Center

COMNAVAIR—Commander, Naval Air Systems Command

COMNAVAIRACFTCUST—Commander Naval Air Aircraft Custodian

COMNAVAIRLANT/PAC—Commander, Naval Air Force, U.S. Atlantic/Pacific Fleet

COMNAVAIRSYSCOM—Commander Naval Air Systems Command

CONUS—Continental United States

COSAL—Coordinated Shipboard Allowance List

COSBAL—Coordinated Shorebased Allowance List

CTS—Contractor Technical Service

CV—Aircraft Carrier

CV(N)—Aircraft Carrier (Nuclear)

CVW—Carrier Air Wing

DAAS—Defense Automatic Address System

DCF—Document Control Form

DCNO—Deputy Chief of Naval Operations

DLH—Direct Labor Hours

DLM—Depot Level Maintenance

DLR—Depot Level Repairable

DOD—Department of Defense

DOP—Designated Overhaul Point

DSF—Data Services Facility

DTG—Date Time Group

E&E—Examination and Evaluation

EDD—Estimated Delivery Date

EI—End Item

EI—Engineering Investigation

EMT—Elapsed Maintenance Time

EOM—End of Month

EOQ—End of Quarter

EOS—Equipment Out of Service hours

EQUIP UTL—Equipment Utilization

ERL—Equipment Reference List

ETR—Engine Transaction Report

ETS—Engineering and Technical Service

ETSREQ—Engineering and Technical Services Request

EXTRACONUS—Outside Continental United States

EXREP—Expeditious Repair

FAA—Federal Aviation Administration

FASOTRAGRU—Fleet Aviation Specialized Operational Training Group

FASU—Fleet Aviation Support Unit

FCA—Field Calibration Activity

FCLP—Field Carrier Landing Practice

FLEAVNMATO—Fleet Aviation Material Office

FLR—Field Level Repairable

FMC—Full Mission Capable

FMCM—Full Mission Capable—Maintenance

FMCS—Full Mission Capable—Supply

FMSO—Fleet Material Support Office

FOD—Foreign Object Damage

FOM—Facilitate Other Maintenance

FOUO—For Official Use Only

FS—Fleet Support

FSC—Federal Supply Class/Code

FSCM—Federal Supply Code for Manufacturers

FSR—Field Service Representative

FY—Fiscal Year

GAO—General Accounting Office

GFA—Government Furnished Accessories

GFAE—Government Furnished Aircraft Equipment

GFE—Government Furnished Equipment

GMT—Greenwich Mean Time

GPE—General Purpose Equipment

GPETE—General Purpose Electronics Test Equipment

GSA—General Services Administration

GSE—Ground Support Equipment

GTC—Gas Turbine Compressor

HMI—Handbook of Maintenance Instructions

HOI—Handbook of Overhaul Instructions

IAW—In Accordance With

ICP—Inventory Control Point

ICRL—Individual Component Repair List

IE—Industrial Engineering

ILSP—Integrated Logistic Support Program/Plan

IM—Item Manager

IMA—Intermediate Maintenance Activity

IMP—Improved Maintenance Program

IMRL—Individual Material Readiness List

INC—Incorporated

INT—Intermediate

IOL—Initial Outfitting List

IP—Item Processed

IPB—Illustrated Parts Breakdown

IPBM—Illustrated Parts Breakdown Manual

IPC—Illustrated Parts Catalog

ITD—Interim Technical Directive

JCN—Job Control Number

JCS—Joint Chiefs of Staff

JSL—Joint Stock List

KCN—Kit Control Number

KIN—Kit Identification Number

KN—Kit Number

LC—Labor Code

LHA—Helicopter Assault Landing Ship

LOX—Liquid Oxygen

LPH—Amphibious Assault Ship

LSR—Logistic Support Requirement

MAAG—Military Assistance Advisory Group

MAC—Military Airlift Command

MAD—Marine Aviation Detachment

MAG—Marine Air Group

MARCORPS—Marine Corps

MAW—Marine Air Wing

MC—Mission Capable

M/C—Maintenance Control

M/C—Material Control

MCC—Material Control Center

MCC—Material Control Code

MCRC—Master Component Rework Capability

MCRL—Master Component Repair List

MDR—Maintenance Data Report/Reporting

MDR—Master Data Records/Report

MDS—Maintenance Data System

MDS—Mission Design Series

MDU—Material Delivery Unit

MEAL—Mobile Equipment Allowance List

MEASURE—Metrology Automated System for Uniform Recall and Reporting

MEPP—Mobile Electric Power Plant

METCAL—Meteorology and Calibration Program

MFG—Manufacturer

MHA—Manhour Accounting

MHAC—Manhour Accounting Card

MI—Maintenance Instruction

MIARS—Maintenance Information Automated Retrieval System

MILSPEC—Military Specification

MILSTD—Military Standard

MILSTRIP—Military Standard Requisitioning and Issue Procedure

MIM—Maintenance Instruction Manual

MIN:ETAUTH—Minimize: Electronic Transmission Authorized

ML—Maintenance Level

MM—Model Manager

MMM (3-M)—Maintenance and Material Management System

MO—Maintenance Officer

MOD—Model/Modification/Modify

MOS—Military Occupational Speciality

MOT—Maximum Operating Time

MPR—Monthly Production Report

MPRL—Master Parts Reference List

MRC—Maintenance Requirement Card

MRF—Module Repair Facility (Ground Support Equipment)

MRIL—Master Repairable Item List

MRL—Master Repair List

MS—Military Standard/Service/Specification

NA—Not Applicable

NADC—Naval Air Development Center

NAEC—Naval Air Engineering Center

NAESU—Naval Aviation Engineering Service Unit

NAF—Naval Air Facility

NALC—Naval Aviation Logistics Center

NALCOMIS—Naval Aviation Logistics Command Management Information System

NAMP—Naval Aviation Maintenance Program

NAMSO—-Navy Maintenance Support Office

NAMT—Naval Air Maintenance Trainer

NAMTD—Naval Air Maintenance Training Detachment

NAMTRA—Naval Air Maintenance Trainer

NAMTRADET—Naval Air Maintenance Training Detachment

NAMTRAGRU—Naval Air Maintenance Training Group

NAPI—Naval Aeronautical Publications Index

NARF—Naval Air Rework Facility

NARTU—Naval Air Reserve Training Unit

NAS—Naval Air Station

NATC—Naval Air Test Center

NATOPS—Naval Air Training and Operating Procedures Standardization

NATSF—Naval Air Technical Services Facility

NAVAIR—Naval Air Systems Command

NAVAIRDEVCEN—Naval Air Development Center

NAVAIRENGCEN—Naval Air Engineering Center

NAVAIRSYSCOM—Naval Air Systems Command

NAVAIRTECHSERVFAC—Naval Air Technical Services Facility

NAVAVNLOGCEN—Naval Aviation Logistics Center

NAVCOMPT—Comptroller of the Navy

NAVELEX—Naval Electronics Systems Command

NAVFAC—Naval Facilities Engineering Command

NAVFACENGCOM—Naval Facilities Engineering Command

NAVMAT—Naval Material Command

NAVMASSO—Navy Maintenance And Supply Systems Office

NAVSAFECEN—Naval Safety Center

NAVSUP—Naval Supply Systems Command

NAVSUPFAC—Naval Support Facility

NC—Not Carried

NCO—Non Commissioned Officer

NDI—Non-Destructive Inspection

NEC—Navy Enlisted Classification

NETS—Navy Engineering and Technical Services

NHA—Next Higher Assembly

NIIN—National Item Identification Number

NINC—Not Incorporated

NIS—Not in Stock

NIS—Not Issued (Directives)

NMC—Not Mission Capable

NMCM—Not Mission Capable—Maintenance

NMCS—Not Mission Capable—Supply

NMDL—Navy Management Data List

NMP—Navy Manning Plan

NOAP—Naval Oil Analysis Program

Non-RFI—Not Ready For Issue

NOTAL—Not to All

NPFC—Navy Publications and Forms Center

NSC—Naval Supply Center

NSI—Not Stocked Item

NSN—National Stock Number

NWESA—Naval Weapons Engineering Support Activity

NWPL—Naval Warfare Publication Library

OBS—Obsolete (Equipment)

OJT—On-the-Job-Training

OLSP—Operational Logistics Support Plan

OMA—Organizational Maintenance Activity

OMD—Operations Maintenance Division

OOD—Officer of the Day/Deck

OPNAV—Office of the Chief of Naval Operations

OPTAR—Operational Target (Funding)

ORG—Organizational

ORIG—Origin/Original

PAR—Personnel Advancement Requirements

PC—Production Control

PDO—Property Disposal Officer

PDR—Preliminary Design Review

P&E—Planner and Estimator

PEB—Pre-Expended Bin

PGSE—Peculiar Ground Support Equipment

PHST—Packaging, Handling, Storage and Transportation

PM—Preventive Maintenance

PMC—Partial Mission Capable

PMCM—Partial Mission Capable—Maintenance

PMCS—Partial Mission Capable—Supply

PME—Precision Measuring Equipment

PMIC—Periodic Maintenance Information Cards

PMK—Phase Maintenance Kit

PMRM—Periodic Maintenance Requirements Manual

PMS—Planned Maintenance System

P/N—Part Number

POD—Proof Of Delivery

PQS—Personnel Qualification Standards

PREX—Pre-Expended

PRI—Priority

PRT—Power Recovery Turbine

PUB—Publication

PW—Public Works

QA—Quality Assurance

QAR—Quality Assurance Representative

QC—Quality Control

QDR—Quality Deficiency Report

QEC—Quick Engine Change

QECA—Quick Engine Change Assembly

QECK—Quick Engine Change Kit

RAC—Rapid Action Change

RAMEC—Rapid Action Minor Engineering Change

REU—Requisition Expeditor Unit

RFI—Ready For Issue

RFU—Ready For Use

RIC—Repairable Item Code

SAF—Support Action Form

SAR—Search and Rescue

SARDIP—Stricken Aircraft Reclamation and Disposal Program

SCA—Stock Control Activity

SCC—Sequence Control Chart/Card

SCIR—Subsystem Capability and Impack Reporting

SCS—Stock Control Section

SCU—Stock Control Unit

SDLM—Standard Depot Level Maintenance

SEB—Support Equipment Bulletins

SEC—Support Equipment Change

SECDEF—Secretary of Defense

SECNAV—Secretary of the Navy

SEL—Support Equipment List

SERS—Support Equipment Requirement Sheets

SERVMART/JETMART—Service/Jet Market

SF—Standard Form

SLEP—Service Life Extension Program

SM&R—Source, Maintenance, and Recoverability (Code)

S/N—Serial Number

SNDL—Standard Navy Distribution List

SPC—Shop Process Card

SRC—Scheduled Removal Component

SRS—Supply Response Section

S&RS—Shipping and Receiving Section

SSC—Supply Support Center

SSS—Supply Screening Section

SSU—Supply Screening Unit

STD—Standard (Equipment)

STE—Special Test Equipment

SUP—Supply

SUPO—Supply Officer

SYS—System

TAD—Temporary Additional Duty

TCPL—Tool Control Plan

TD—Technical Directive

TDC—Technical Directive Compliance

TDY—Temporary Duty (USMC)

TEC—Type Equipment Code

TI—Technical Instructions

TM—Technical Manual

TM—Type Maintenance

T/M/S—Type/Model/Series

TPDR—Technical Publications Deficiency Report

TPH—Technical Publications Holder

TPL—Technical Publications Library

TR—Transaction Report

TRU—Technical Research Unit

TSN—Time Since New

TSO—Time Since Overhaul

TYCOM—Type Commander

VAST—Versatile Avionics Shop Test

APPENDIX II

DEFINITION OF TERMS

The definitions listed here are some of those that you as an AS will most often use. For a more complete list consult Appendix D, OPNAVINST 4790.2B Vol. I, II, and III.

ACCEPTANCE—Assumption of responsibility for, or legal title to, an aircraft from another party. Receipt of new aircraft from a manufacturer (or of any aircraft from a non-Navy custodian) by a representative authorized to do so by the Navy. Provisional acceptance is the acceptance of an aircraft with the provision that certain obligations with respect to the aircraft have not yet been fulfilled by the contractor. (OPNAVINST 5442.2 series.)

ACCESSORY—See Equipment, Division of.

ACCIDENT, GROUND—A mishap involving Navy aircraft where no intent for flight exists and results in damage to a Navy aircraft. Includes damage to aircraft not in operation caused by windstorms, floods, hangar fires, etc. (See the current edition of OPNAVINST 3750.6 series for more detailed definition.)

ACCUMULATED HOURS—Hours expended against a job by individuals or shops within the same work center.

ACTION DATE—The Julian date on which maintenance form is completed by a work center for submission.

ACTION ORGANIZATION—The activity that actually performs the maintenance action and is identified by a three-character code.

ACTION TAKEN CODE—See Data Collection Codes, 3-M.

ACTIVE METAL—A metal that is prone to corrosion under certain conditions. In a Galvanic cell, an active metal readily releases its electrons to the more noble metal.

ACTIVITY, AVIATION—See Aviation Activity.

ACTIVITY, MAINTENANCE—See Maintenance Activity.

ADJUST/ALIGN/TRIM—To bring within specified limits the variable elements of an item.

ADMINISTRATIVE CHAIN OF COMMAND—The normal chain of command as determined by the administrative organization.

ADMINISTRATIVE COMMANDS—(Type Commands)—The commands that provide tactical commands with the means to conduct tactical operations. Administration of training, supply, and repair of fleet units are some of their responsibilities.

ADVANCE PROCUREMENT PLAN (APP)—The long-range advance procurement plan, forwarded to the Chief of Naval Material for review and approval, that sets forth procurement objectives such as completion, component breakout, acquisition of technical data for procurement, type of contract contemplated, contract award date, etc.

AERONAUTICAL ALLOWANCE LISTS—Includes publication identified as NAVAIR Allowance Lists (except advanced base lists). NAVAIR Initial Outfitting Lists, and NAVAIR Tables of Basic Allowances. Aeronautical Allowance Lists are lists of equipment and material determined from known or estimated requirements as necessary to place and maintain aeronautical activities in a material readiness condition. In the case of aerological and photographic material, this requirement is extended to all applicable naval activities.

a. ALLOWANCE LISTS—Documents which are used to specify authorized requirements of Operational Support Inventory (OSI) for a squadron, Aircraft Intermediate Maintenance Department (AIMD) or ship. The allowance specified is based on the activity's need for the item to perform its mission, the level of maintenance effecting repair, and the frequency use.

b. ALLOWANCE PARTS LIST (APL)—The APL is a technical document prepared for individual equipment/components and their repair.

c. AVIATION CONSOLIDATED ALLOWANCE LIST (AVCAL)—A consolidated list of aeronautical material tailored to each individual ship and Marine Aircraft Group (MAG) to support assigned or embarked aircraft and carrier/MAG flight operations. The AVCAL is normally prepared by ASO under direction of the Air Type Commander.

d. COORDINATED SHIPBOARD ALLOWANCE LIST (COSAL)—A COSAL is a shipboard/shore based allowance list tailored to suit an individual ship or MAG material support requirements and serves as both a technical and supply document. It is technical, in that equipment, nomenclature, operating characteristics, applicable technical manuals, plans, repair parts and special tool requirements for the operation and repair of shipboard equipment are described/documented therein; supply, in that the COSAL reflects, by equipment, the National Stock Number for each required item supported in the Naval Supply System. It is a consolidated listing of shipboard spares, repair parts equipage and consumable allowances and provides the basis for shipboard inventory management and development of second and third echelon support requirements. The COSAL is prepared by the Ship Parts Control Center for ships hull, mechanical, electrical and ordnance installed equipment; for NAVELEX to provide allowance material for ships' installed and portable electronic equipment, and; for the ASO for the Naval Intelligence Processing System.

e. INITIAL OUTFITTING LISTS (IOLS)—Documents which are used to determine authorized requirements of spare assemblies and repair parts required at the intermediate and organizational levels of maintenance. These would be storeroom items under control of the Supply Department.

AERONAUTICAL EQUIPMENT SERVICE RECORD (AESR)—An insert to the basic Aircraft Logbook used as a service record for various aircraft equipment such as power plants and propellers.

AIR COMMAND—See Controlling Custodian.

AIRCRAFT CONTROLLING CUSTODIAN—A term applied to Air Commands and NAVAIR for exercising administrative control of assignment employment and logistic support of certain aircraft and aircraft engines as specified by CNO. The following aircraft controlling custodians have been designated: by CNO:

COMNAVAIRLANT
COMNAVAIRPAC
CNATRA
CNAVRES
NAVAIR (Aircraft Control Branch Air 6104)

AIRCRAFT CUSTODY—See Custody.

AIRCRAFT INTERMEDIATE MAINTENANCE DEPARTMENT—That department of an aviation ship (CV/LPH/LHA) or station responsible for the check, test repair or manufacture of aeronautical components and support equipment associated with those aircraft supported.

AIRCRAFT MAINTENANCE AND MATERIAL READINESS LIST (AMMRL)—PROGRAM—A broad program that provides for the development of data and documentation needed to determine and establish requirements and inventory control of aircraft ground support equipment. Within this program, the following terms are significant:

a. Application Data for Material Readiness List (ADMRL)—Data specifying the requirement for each item of aircraft ground support equipment against intermediate and/or organizational levels of maintenance and selected ranges of each aircraft/engine/system for which each item is needed. This data is "stored" in computers and used to develop Individual Material Readiness Lists.

b. Individual Material Readiness List (IMRL)—A consolidated list specifying items and quantities of ground support equipment required for material readiness of the aircraft ground activity to which the list applies. These lists are constructed by extracting those applicable portions of the application data (ADMRL) that pertain to the maintenance and material logistics responsibilities of the activity to which the list applies. Each IMRL contains a set of instructions explaining its use and arrangement. (See NAVAIRINST 4420.1 Series for amplifying information.)

AIR FORCE NAVY NUMBERS (AN)—Numbers used to designate aeronautical parts manufactured in accordance with Air Force-Navy aeronautical specification. (See NAVWEPS 00-25-543.)

APPLICATION DATA, MATERIAL READINESS LIST (ADMRL)—See Aircraft Maintenance and Material Readiness List (AMMRL) Program.

APPROPRIATION—An authorization established by an Act of the Congress of the United States to spend funds of the U.S. Treasury, or incur indebtedness, for specified purposes. The appropriation Operation and Maintenance, Navy (O&MN), is established for each fiscal year concerned to fund the operation and maintenance requirements of the operating forces. The appropriation is only available for citation on requisitions for the fiscal year established and for the recording of related expenditures for the following two years thereafter.

ARTICLE (Equipment or End Item)—Consists of components, assemblies, subassemblies, and parts connected or associated together to perform an operational function.

ASSEMBLY—See Equipment, Division of.

ASSIGNMENT—Statement of fact of positive intention that specifically designated aircraft are or will be in the custody of specifically designated organizational units.

ATTACHMENT—See Equipment, Division of.

AUDIT—As applied to the Quality Assurance Program, a periodic evaluation of detailed plans, policies, procedures products, directives, and records. See also Management Audit.

AUGMENTED SUPPORT—An interim arrangement during initial development or production or from stocks maintained by the contractor items for the support of the equipment, or on as-required basis, pending assumption of support responsibility by the government.

AUTOMATIC DISTRIBUTION—The action that provides initial distribution of publications to newly activated aircraft squadrons or ships and that provides definite follow-on distribution of supplements, etc.) to recipients of publications on initial distribution or to authorized requestors.

AUTOMATIC TEST EQUIPMENT (ATE)—Equipment that carries out a predetermined program of testing for possible malfunction without reliance upon human intervention. Also called automatic-checkout equipment.

AUTOMATIC TESTING—Determination of fault localization, possible failure prediction, or validation of satisfactory operation (of equipment) by a device that is programmed to perform a series of self-sequencing test measurements. Once actuated, the device will continue its operations without the necessity of human direction.

AVAILABLE MAN-HOURS—Available man-hours are net assigned man-hours plus labor code gain and overtime, less labor code loss.

AVIATION ACTIVITY—A formally structured staff, command, squadron, unit, or detachment headed by a commander, commanding officer, or officer-in-charge responsible for the management, maintenance/material, logistic support of naval aeronautical equipment. See also Maintenance Activity.

AVIONICS—The application of electronics to aviation and astronautics.

NOTE

> For purposes of the Naval Aviation Maintenance Program, avionics is interpreted to include electronic, electrical, instrument, flight control, fire control, and bombing equipments and their subsystems taken either as independent equipments groups of equipment, or integrated systems to accomplish assigned military missions.

AWAITING MAINTENANCE (AWM) TIME—That time during which support equipment is down and no maintenance work is being performed on it. Other maintenance upkeep not causing a NMCM/PMCM condition may be performed on the aircraft during this period.

AWAITING PARTS (AWP)—The condition that exists when materials are not available on station/ship to complete a maintenance action.

BACK ORDER—A generic term applied to commitments made to customers by inventory managers that material required by the customer will be available by a specified date to fill:

a. Requisitions that cannot be filled from system stocks within the Uniform Military Material Issue Priority System's time frame.

b. Firm or anticipated customer requests for delivery of material at a future date.

BENCH CHECK—A physical inspection or functional test of an item removed for an alleged malfunction to determine if the part or item is serviceable or repairable. It also includes a determination of the extent of maintenance or repair and possible overhaul required to return it to serviceable status.

BENCH TEST—The subjection of aircraft, engine accessories, equipment, and equipage to prescribed conditions and specifications with the use of shop test equipment to ensure proper functioning. See also Test.

BENEFICIAL SUGGESTION—A constructive idea relating to an official operation submitted in writing by an employee or a group of employees to management for evaluation.

BEYOND CAPABILITY OF MAINTENANCE (BCM)—A term/code utilized by intermediate maintenance when repair is not authorized at that level or when an activity is not capable of accomplishing the repair because of a lack of equipment, facilities, technical skills, technical data, or parts. This code will also be utilized when a shop backlog precludes repair within time limits specified by existing directives.

BUILT-IN TEST EQUIPMENT (BITE)—Any device permanently mounted in the prime equipment and used for the express purpose of testing the prime equipment, either independently or in association with external test equipment.

BULLETIN—A technical publication issued by NAVAIR which (1) directs a one-time inspection of equipment and contains related instructions, and (2) disseminates administrative/management information as related to maintenance of weapon systems.

BUREAU NUMBER (BUNO)—An unhyphenated serial number, not exceeding six digits, used to identify individual airframes within the Naval aircraft inventory. Each number is unique to a particular airframe. Assignment is controlled by the Chief of Naval Operations (OP-511).

CALENDAR AGE—The total number of calendar months since acceptance.

CALIBRATE—To determine and make required corrections in calibration standards or PME used in precise measurement. Consists of the comparison of two instruments, one of which is a certified calibration standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the other instrument or PME being compared with the certified calibration standard.

CALIBRATION—The process by which calibration installations compare a calibration standard or PMS with a standard of higher accuracy to ensure that the former is within specified limits throughout its entire range. The calibration process involves the use of approved instrument calibration procedures. See also Precision Measuring Equipment.

CALIBRATION FACILITY—An installation under the control of the military departments or any agency of the DOD that provides calibration services for precision measuring equipment of calibration standards used by activities engaged in RDT&E, production, quality assurance, maintenance, supply and operation of weapons systems, equipment, and other DOD material.

CALIBRATION INTERVAL—The maximum length of time between calibration during which calibration standard or precision measuring equipment is expected to maintain reliable measurement capability.

CALIBRATION/MEASUREMENT REQUIREMENTS SUMMARY (C/MRS)—A summary of the technical requirements of systems, subsystems, or equipment that outlines the parameters of each echelon of measurement.

CALIBRATION SCHEDULE—A document distributed periodically listing PME that each activity will submit to a designated laboratory for calibration.

CANNIBALIZE—Removal of serviceable parts from one aircraft or equipment for installation on another aircraft or equipment.

CAPILLARY ACTION—Where a liquid surface is raised or lowered when it is in contact with a porous solid. The liquid movement is dependent on the relative attraction of the liquid molecules for each other called surface tension, and for the solid molecules.

CATHODE—The unattacked electrode of the corrosion cell where reduction occurs. In a Galvanic cell, the cathode is the less active metal which will not corrode.

CELL—Corrosion cycle. Electrochemical process which consists of four elements: anode, cathode, electrolyte, and electron path.

CHANGE—A technical publication issued by NAVAIR which directs, and provides instruction for, the accomplishment of a change, modification, repositioning or alteration of material in inservice aircraft, weapons, systems, assemblies, subassemblies, components or support equipment. (See Technical Directive.)

CHANGE SYMBOL—Revised text is annotated by a black vertical line in either the right or left margin.

CHECKOUT—A sequence of functional, operational, calibrational tests to determine the condition and status of a weapon system or element thereof.

CHLORIDES—Chlorine compounds, many varieties of which are present in seawater. These compounds contribute to the corrosive strength of seawater.

COATING—Paint, preservative compounds, etc., and inorganic layers formed by anodizing and chemical conversion.

COGNIZANT FIELD ACTIVITY (CFA)—An activity that has been delegated the authority and assigned the responsibility to perform specified engineering functions.

COGNIZANCE SYMBOLS—Alphabetical or alphabetical-numerical codes prefixed to Navy stock numbers to identify and designate the bureau, office, or supply demand control point that exercises supply management over specified categories of material. See also Material Cognizance.

COMMOND GROUND SUPPORT EQUIPMENT—See Ground Support Equipment.

COMMON ITEM—An item of standard design, application, and specification normally procurable from several manufacturers or suppliers or available from only one manufacturer but with wide usage or of such design that the multiple application is apparent.

COMPONENT—See Equipment, Division of.

COMPONENT CONTROL SECTION (CCS)—The section of the SSC (Supply Support Center) that has accounting responsibility for all components (i.e., pool, in process of repair).

COMPONENT REPAIR—See Maintenance Levels.

CONCENTRATION CELL—Corrosion that is initiated by the difference in concentration of dissolved oxygen or metal ions in the electrolyte. Concentration cells are associated with crevice areas where water is entrapped.

CONDITION CODES—See Material Condition Code.

CONSOLIDATED GROUND SUPPORT EQUIPMENT LIST (CGSEL)—Reflects a summary of Government decisions on contractor's GSE recommendations and other pertinent data relative to support of the end article. It is a list of contractor recommended ground support equipment items.

CONSOLIDATED REMAIN IN PLACE LIST (CRIPL)—A listing of all authorized remain in place items published by ASO and approved by TYCOMs and NAVAIR. No other RIP listings are to be used locally to retain items on aircraft or equipment pending receipt of a replacement.

CONSUMABLE ITEM—Any item or substance which, upon installation, loses its identity and is normally consumed in use or cannot be economically repaired.

CONSUMABLE MATERIALS—See Expendable Supplies and Material.

CONTAMINANTS—Particles of foreign material which may or may not be visible to the unaided eye. Contaminants are typically organic, metallic, rust, dust, dirt or water and will substantially degrade hydraulic system performance and component life.

CONTRACT—The legal agreement between DOD and industry, or similar internal agreement wholly within the Government, for the development, production, maintenance, or modification of an item(s).

CONTRACT MAINTENANCE—

a. The maintenance of material by commercial organizations on a one-time or continuing basis without distinction as to levels of maintenance accomplished.

b. Maintenance accomplished by private industry in Government-owned, contractor-operated or contractor-owned, contractor-operated plants or by contract field teams.

CONTRACTOR—An individual, partnership, company, corporation, or association having a contract with the procuring activity for the design development, design and manufacture, manufacture, maintenance, modification, or supply of items or service under the terms of a contract. A Government activity performing any or all of the above actions is considered to be a contractor for configuration management purposes.

CONTRACTOR ENGINEERING AND TECHNICAL SERVICES (CETS)—Those services performed by commercial or industrial companies which provide advice, instruction and training to personnel of the military departments in the installation operation, and maintenance of DOD aeronautical systems and equipment.

These services include transmitting the knowledge necessary to develop among the personnel the technical skills required for installing, maintaining, and operating such equipment in a high state of military readiness. CETS consists of:

a. Contractor Plant Services (CPS)—These services provided to personnel of the military departments in the plants and facilities of the manufacturer of military equipment or components by trained and qualified engineers and technicians employed by the manufacturer. The specialized skills, knowledge, experience, and technical data of the manufacturer are contracted for by DOD components for the purposes of acquiring system and component knowledge, training, and training aid programs relating directly to the development among these personnel of the technical skills required for installing, maintaining, and operating such equipment.

b. Contract Field Services (CFS)—Those engineering and technical services provided to DOD personnel by commercial or industrial companies on-site at defense locations by trained and qualified engineers and technicians. CFS personnel must possess specialized knowledge.

c. Field Service Representative (FSR)—An employee of a manufacturer of military equipment or components who provides a liaison of advisory service between his company and military users of his company's equipment or components. This service is an important element in providing a technical communication channel between the producer and the military field users.

CONTRACTOR FURNISHED EQUIPMENT (CFE)—Items manufactured or purchased by the contractor for inclusion in or support of the aeronautical system.

CONTROLLING CUSTODIAN—A term applied to Air Commands and NAVAIR Fleet Support exercising administrative control or assignment, employment, and logistic support of certain aircraft, and aircraft engines as specified by CNO. Controlling custodians, other than NAVAIR (FS), are also referred to as Operating Commands.

CONTROLLING CUSTODY—See Custody.

CONVERSION COATING—A chemical treatment which results in a protective film on the metal surface. Metals such as aluminum and magnesium are coated to enhance paint adhesion.

CORRECTIVE MAINTENANCE—The actions performed, as a result of failure, to restore an item to a specified condition.

CORROSION—The electrochemical deterioration of a metal reacting with its environment.

CORROSION FATIGUE—Effect of corrosion and cyclic stress on metal. This type of corrosion is usually associated with high strength alloys.

CORROSION RATE—Corrosion expressed in terms of weight or thickness (mils).

CREW SCHEDULING—See Maintenance Schedule.

CRITICAL ITEM—An essential item that is in short supply or expected to be in short supply for an extended period. See also Critical Supplies and Materials; Regulated Item.

CRITICAL SUPPLIES AND MATERIALS—Those supplies vital to the support of operations which for various causes, are in short supply or are expected to be in short supply. See also Critical Item and Regulated Item.

CUSTODY—Cognizance of aircraft, involving some responsibility therefore (also applies to equipage, equipment, material, and support equipment):

a. Controlling Custody—Administrative control of the assignment, logistic support, employment, and responsibility to account for and otherwise provide information about the aircraft.

b. Physical Custody—Actual possession of the aircraft for a definite purpose. This does not necessarily imply Reporting Custody.

c. Reporting Custody—Squadron (or other reporting unit) responsibility to account for and otherwise provide information about assigned aircraft. This does not necessarily imply Physical Custody.

CUSTOMER SERVICE—The providing of depot level services, including the emergency check, test and/or minor repair, manufacture of parts, heat treat plating, machine shop service, etc., in the processing of material to relieve NMCS/PMCS and work stoppage conditions. Refer to OPNAVINST 3750.6 Series.

DATA—The means for communication of concepts, plans, descriptions, requirements, and instructions relating to technical projects, material, systems, and services. These may include specifications, standards, engineering drawings, associated lists, manuals, and reports, including scientific and technical reports; they may be in the form of documents, displays, sound records, punched cards, and digital or analog data.

DATA COLLECTION CODES—3-M Codes used in MHA and MDS are:

a. Action Taken Code—A one-character alphabetic or numeric code that describes what action has been accomplished on the item identified by the work unit code.

b. Assigned Labor Code—A three-character numeric labor code used to identify an individual's primary job (requirements) or assignment.

c. Awaiting Maintenance Reason Code—A one-character numeric code that describes the reason for an Awaiting Maintenance (AWM) condition.

d. Grade Code—A five-digit alpha numeric code that identifies a pay grade.

e. Labor Code—A three-character numeric or alpha numeric code that identifies a type of labor.

f. Malfunction Description Code—A three-character numeric code used to describe the malfunction occurring on or in an item identified by a work unit code.

g. Manufacturer's Code—A five-character alphanumeric code that identifies the manufacturer of a component, part, end item, etc.

h. Organization Code—A structured three-character alphanumeric code that identifies activities within a major command.

i. Sub-Labor Code—A fine breakdown of the basic labor code that may be used as directed by major commands.

j. Support Action Code—A three-character alphanumeric code that identifies specific categories of support type work of a repetitive nature not involving malfunctions, repairs, BCM, or condemnation actions.

k. Technical Directive Code (TDC)—A two-character numeric code that identified the type of technical directive.

l. TDC Status Code—A one-character alphabetic code used to indicate the status of compliance with a technical directive.

m. Technical Directive Identification Code—A 13-character alphabetic and numeric code used to identify a specific technical directive.

n. Transaction Code—A two-character numeric code used to denote the type of data being reported and to indicate the card type to be produced.

o. Type Equipment Code—A four-character alphanumeric code that identifies a complete end item or an equipment category.

p. Type Maintenance Code—A one-character alphabetic code that identifies the type of maintenance performed.

q. When Discovered Code—A one-character code that identifies when the need for maintenance was discovered.

r. Work Center Code—A three-character code that identifies a work center.

s. Work Unit Code—A three-, five-, or seven-character alphanumeric code that identifies the system, subsystem, and component or part of the end item.

DATA SERVICES FACILITY—The activity that converts documented data into data processing machine records and utilizes these records to produce machine reports, listing, and preprinted/prepunched cards.

DAYS—Calendar days.

DEPOT MAINTENANCE—See Maintenance Levels.

DESIGN ACTIVITY—An activity having responsibility for the design and preparation and maintenance of engineering documents for a given item of military property. The activity may be a Government activity, contractor, vendor, or others.

DESIGNATED OVERHAUL POINT (DOP)—A depot level rework facility assigned the technical and rework responsibility for a given aeronautical system, subsystem, or component.

DESIGNATED REWORK POINT (DRP)—A depot level rework facility assigned the technical and rework responsibility for a given aeronautical system, subsystem, or component.

DETACHMENT—A temporary reporting custodian formed with aircraft assigned from a parent squadron or unit. Detachments are established when a squadron deploys one or more aircraft to a ship or base substantially removed from the location of the parent organization and/or the parent squadron Commanding Officer feels that it would be impractical to retain reporting custody of the aircraft so deployed. Detachments have the same responsibilities, with respect to the requirements of this instruction, as all other reporting custodians of aircraft. (See OPNAVINST 5442.2 Series.)

DEVELOPMENTAL GROUND SUPPORT EQUIPMENT—See Ground Support Equipment.

DEVIATION—A specific written authorization, granted prior to the manufacture of an item, to depart from a particular performance or design requirement of a specification, drawing, or other document for a specific number of unit or a specific period of time. A deviation differs from an engineering change in that an approved engineering change requires corresponding revision of the documentation defining the affected item, whereas a deviation does not contemplate revision of the applicable specification or drawing.

DIRECTED REMOVAL—A requirement to remove an item after a fixed period of operation because there is insufficient confidence regarding continued satisfactory operation and because failure during operation would have serious consequences.

DIRECTIVE—

a. A military communication in which a policy is issued to go into effect when so directed or if a stated contingency arises.

b. A plan issued with a view to placing it in effect when so directed or if a stated contingency arises.

c. In a broad sense, any communication that initiates or governs action, conduct, or procedure.

DIRECT MAINTENANCE—That effort expended by maintenance personnel in the actual performance of maintenance on the hardware in accordance with the prescribed procedures contained in the applicable technical manuals. It applies equally to both contractor and Government furnished equipment.

DIRECT MAINTENANCE MANHOUR—That effort expended by one man in performing one hour of direct maintenance. See Direct Maintenance.

DIRECT SURFACE ATTACK—A type of corrosion that results from direct reaction between a metal surface and the atmosphere. Rust on iron is a common example.

DOCUMENT—(1) Specifications, drawings, sketches, lists, standards, pamphlets, reports, and printed, typewritten, or other information relating to the design, procurement, manufacture, test, or inspection of items or services under a contract. (2) In the MDS, any of the forms used to collect data at its source for conversion to machine records.

DOWNTIME—That element of time during which the item is not in condition to perform its intended function.

DWELL—The time that is spent between mixing a compound (e.g. paint) and its use.

ELAPSED MAINTENANCE TIME (EMT)—The actual clock time in hours and tenths during which maintenance is performed on a job.

ELECTRONICS—The science and technology concerned with devices involving the emission, behavior, and effect of electrons in vacuums, gases, and semiconductors. Technically, electronics is a broad term extending into divergent fields and it is necessary to define the scope covered by electronics in terms of "electronic material."

END ARTICLE (EA)—An end weapon, aircraft system, subsystem, component, or equipment, e.g., transmission, engine, computer, radio, etc., being procured on the contract, including contractor furnished material. See End Item.

END ITEM (EI)—A final combination of end products, component parts, and/or materials that is ready for its intended use, e.g., ship, tank, mobile machine shop, aircraft. See End Article.

ENGINE ACCESSORIES—Those items of equipment required for engine operation that are not an integral part of the engine. Such equipment is included in the engine Illustrated Parts Breakdown (IPB) (From the manufacturer's Bill of Material) and in most cases is attached to the engine but in special situations could be airframe mounted. Examples are oil pumps, fuel controls, engine-driven fuel pumps, temperature amplifiers, afterburner controls, carburetors, magnetics, distributors, and ignition harnesses.

ENGINEERING CHANGE PROPOSAL (ECP)—A term that includes both the documentation by which the change is described and suggested.

EQUIPAGE—Normally the noninstalled articles that make up the configuration on aircraft. Not usually associated with a specific model of aircraft. Examples are life rafts, parachutes, safety belts, survival equipment, portable fire extinguishers, flight clothing, and similar items. An aircraft, as such, could be operated without equipage.

EQUIPMENT—All articles needed to outfit an individual or organization. The term refers to clothing, tools, utensils, vehicles, weapons, and similar items. As to type of authorization, equipment may be divided into special (or project) equipment, equipment prescribed by tables of allowance, and equipment prescribed by tables of organization and equipment. See also Individual Equipment Material, and Organizational Equipment.

EQUIPMENT ALLOWANCE LISTS—A generic term indicating the publication, or sections thereof, in the military services that prescribe the equipment and weapons authorized for military organizations, air units aboard ships, individual military personnel, and administrative equipment at posts or bases.

EQUIPMENT, APPLICABILITY INDEX—Part II of the Naval Aeronautical Publications Index (NAVAIR 00-500); a listing of aircraft and equipment arranged in alphabetical order, with applicable manuals shown by their publication number.

EQUIPMENT, DIVISION OF—The following is a sequential listing of equipment divisions:

a. Part—One piece, or two or more pieces joined together that are not normally subject to disassembly without destruction of the designed use. Examples are outer front wheel bearing of 3/4-ton truck, electron tube, composition resistor, screw, gear, mica capacitor, audio transformer and milling cutter.

b. Subassembly—Two or more parts that form a portion of an assembly or a unit replaceable as a whole, but having a part or parts that are individually replaceable. Examples are gun mount stand, window sash, recoil mechanism, floating piston, telephone dial, IF strip and terminal board with mounted parts.

c. Component/Assembly—A number of parts or subassemblies or any combination thereof joined together to perform a specific function. This term applies to items that cannot be further disassembled for test or repair without requiring shop facilities. Examples are fan assembly, oxygen converter assembly, receiver transmitter assembly, and amplifier assembly.

NOTE

The distinction between an assembly and a subassembly is not always exact, an assembly in one instance may be a subassembly in another where it forms a portion of an assembly.

d. Unit—An assembly or any combination of parts, subassemblies, and assemblies mounted together, normally capable of independent operation in a variety of situations. Examples are hydraulic jack, electric motor, electronic power supply, internal combustion engine, electric generator, and radio receiver.

NOTE

The size of an item is a consideration in some cases. An electric motor for a clock may be considered a part since it is not normally subject to disassembly.

e. Group—A collection of units, assemblies, or subassemblies, that is a subdivision of a set or system but is not capable of performing a complete operational function. Examples are antenna group and indicator group.

f. Set—A unit or units and necessary assemblies, subassemblies, and parts connected or associated together to perform an operational function. ("Set" is also used to denote a collection of like parts such as a "tool set" or a "set" of tires.) Examples are radio receiving set, radarhoming set, and sound measuring set, which includes such parts, assemblies, and units as cable, microphone, and measuring instruments.

g. Subsystem—A major portion of a system that performs a specific function in the overall operational function of the system. Examples include the Nose Landing Gear System, Aileron System, and Radar Altimeter System. The third digit of the code normally identifies a subsystem.

h. System—A complete system within the weapon such as Landing Gear System, Flight Control System, Radar Navigation System, etc.

EQUIPMENT MAINTENANCE MANAGEMENT—The process of developing the workload requirements forecast and planning, organizing, staffing, directing, and controlling the engineering, industrial, and other resources necessary to effectively and economically support the equipment operation objectives of the military departments and Office of the Secretary of Defense.

EQUIPMENT STATISTICAL DATA—Historical information relating to maintainability and reliability characteristics of systems, subsystems, and components for weapons and end item equipments during their operational application.

EQUIPMENT STATISTICAL DATA (ESD) CARD—A single copy Electric Accounting Machine (EAM) Card used to record aircraft readiness and inventory data.

EQUIPMENT, SUPPORT—See Ground Support Equipment.

EVALUATION—

a. Operational—The test and analysis of a specific end item or system, insofar as practical under service operating conditions, to determine if quantity production is warranted based on (1) the increase in military effectiveness to be gained and (2) its effectiveness as compared with currently available items of systems, with consideration given to: (a) personnel capabilities to maintain and operate the equipment; (b) size, weight, and location; and (c) enemy capabilities in the field.

b. Technical—The study and investigations by a developing agency to determine the technical suitability of material, equipment, or a system for use in the military services.

EXAMINATION—An element of inspection consisting of investigation, without the use of special laboratory appliances or procedures, of supplies and services to determine conformance to those specified requirements that can be determined by such investigations. Examination is generally nondestructive and includes, but is not limited to, visual, auditory, olfactory, tactile, gustatory, and other investigations; simple physical manipulation; gauging; and measurement.

EXCEPTION PRINCIPLE—For the purpose of maintenance data collection, the principle that only deviations from established norms are singled out for attention.

EXCESS PROPERTY—The quantity of property in possession of any component of DOD that exceeds the quantity required or authorized for retention by that component. See Property.

EXCHANGEABLE PARTS AND MATERIAL—Those parts and material that have a potential use of more than once and are usually economically repairable.

EXFOLIATION—A form of corrosion evidenced by initial bulging and flaking off of deteriorated metal layers.

EXPENDABLE SUPPLIES AND MATERIAL—Supplies that are consumed in use, such as ammunition, paint, fuel, cleaning and preserving materials, surgical dressings, drugs, medicines, etc., or that lose their identity, such as spare parts, etc. Sometimes referred to as "consumable supplies and material."

FACILITIES—An aircraft maintenance facility is any building, property or space which is designed for, assigned to or used by aircraft maintenance organizations. Facilities are shops, hangars, work centers, parking areas, etc., both afloat and ashore, which are used for the upkeep, maintenance and repair of aircraft, aircraft weapon systems or aircraft components. Use of the term "facilities" is not to be interpreted as or construed to mean organization, personnel or material. However, facilities do usually include installed aircraft support equipment.

FACILITY—

a. A physical plant, such as real estate and improvements thereto, including buildings and equipment, that provides the means for assisting or facilitating the performance of a function, e.g., base, arsenal, or factory.

b. Any part or adjunct of a physical plant, or any item of equipment that is an operating entity and contributes or can contribute to the execution of a function by providing a specific type of physical assistance.

FACILITY MAINTENANCE—Routine, recurring work required to keep a facility, plant, building, structure, ground facility, utility system, or any real property in such a condition that it may be continuously utilized, at its original or designed capacity and efficiency, for its intended purpose.

FAILURE—The inability of an item to perform within previously specified limits.

FAILURE RATE—The number of failures of an item per unit measure of life (cycles, time, miles, events, etc., as applicable for the item).

FAYING SURFACES—Metal surfaces in contact such as laps, joints, crevices, etc.

FEDERAL SUPPLY CODE FOR MANUFACTURERS (FSCM)—A coding system of five-digit numbers assigned to establishment which are manufacturers or have design control of items of supply procured by agencies of the Federal Government. (See DOD Cataloging Handbooks H4-1 and H4-2.)

FIELD LEVEL REPAIRABLE (FLR)—A low cost repairable capable of being restored to serviceable condition only at the intermediate level of repair as indicated by the SM&R code. Final disposition of an FLR usually rests with an IMA.

FIX PHASE—The portion of a scheduled inspection that involves the correction of discrepancies found during the look phase.

FRETTING CORROSION—Corrosion where two heavily loaded surfaces, in contact, are subject to vibration sufficient to cause slip.

GALVANIC CELL—A closed electric circuit of two dissimilar metals and an electrolyte.

GALVANIC CORROSION—Accelerated corrosion as a result of electrical contact between dissimilar metals in a corrosive medium.

GALVANIC SERIES—An established order of metals that are listed according to their relative electrical activity.

GAS TURBINE ENGINES—All turbine engines whether used to power flight (including target drones, missiles, and missile targets) for auxiliary power or for starting purposes (airborne or ground units) are included within the meaning of this term.

GENERAL SERVICES ADMINISTRATION (GSA)—An integrated manager responsible for supporting all federal agencies for specific classes of material or specific items within classes assigned to other Integrated Managers.

GOVERNMENT FURNISHED EQUIPMENT (GFE)—Equipment(s) that have been selected and are to be furnished by the Government to a contractor or Government activity for installation in, use with, or in support of the aeronautical system during production, conversion, or modification.

GROUND ACCIDENT—See Accident, Ground.

GROUND INCIDENT—See Incident, Ground.

GROUND SUPPORT EQUIPMENT (GSE)—All equipment required on the ground to make an aeronautical system, command and control system, support system, subsystem or end item of equipment (GSE for GSE) operational in its intended environment. This includes all equipment required to install, launch, arrest (except Navy shipboard and shore-based launching and arresting equipment), guide, control, direct, inspect, test, adjust, calibrate, appraise, gauge, measure, assemble, disassemble, handle, transport, safeguard, store, actuate, service, repair, overhaul, maintain, or operate the system, subsystem, and item or component. This definition applies regardless of the method of development, funding, or procurement. GSE may be categorized as common (general purpose) and peculiar (special purpose); within these categories may exist developmental (no Government-approved specification/drawing) and standard (with Government-approved specification/drawing). These categories of GSE are defined as follows:

a. Common Ground Support Equipment (CGSE)—Comprised of only those general purpose items supplying or measuring broad parameters of physical properties that are known to be established in the using service's inventory, e.g., ground electrical, pneumatic, and hydraulic power units; towing, hoisting, and fueling devices; signal generation devices; voltage, amperage, and phase measuring devices, etc. The application of GSE items to other end articles, systems, or components does not in itself categorize the items as CGSE.

b. Developmental Ground Support Equipment (DGSE)—An item of GSE for which no Government approved specification/drawing exists. This includes GSE items to be designed and developed and commerical items being introduced into the Government inventory.

c. Peculiar Ground Support Equipment (PGSE)—An item of GSE that must be designed and developed in conjunction with the development of an article and that does not meet the criteria of CGSE.

d. Standard Ground Support Equipment (SGSE)—An item of GSE defined by a current Government-approved specification or drawing, or off-the-shelf commercial equipment currently in the Government inventory, for which procurement data are available. For the purpose of this document, the following equipment is excluded in the definition of GSE.

1. Powered and nonpowered hand tools.

2. Housekeeping items.

3. Office furniture and equipment and items common to all activities defined in applicable allowance lists that are required as indirect support.

4. Common production tools and tooling such as lathes, drills, presses, plating equipment grinders, induction heaters, etc.

5. Items used only by the contractor.

6. Personal equipment (head sets, microphones, etc.).

GROUP—See Equipment, Division of.

GROUP MAINTENANCE (MARINE)—See Maintenance Levels—Intermediate Maintenance (field).

HANDBOOK OF SERVICE INSTRUCTIONS—A manual containing instructions required for intermediate and organizational level servicing and maintenance for aircraft components and equipment or support equipment.

HANDBOOK OF STRUCTURAL REPAIR—A manual containing instructions and information or structural repair of a specific model aircraft. Information is provided that will enable inexperienced personnel to determine the extent of damage to aircraft structure and accomplish authorized repairs. Instructions contained in General Repair Manual Series (AN 01—1A) are not duplicated.

HARDWARE/SOFTWARE—Hardware or software or a combination of both, in which the software includes only that required for operational use, e.g., computer programs for command and control, handbooks for operations, maintenance, etc., and excludes fabrication specification, drawings, etc.

HOT-REFUELING—An operational evolution wherein an aircraft is refueled while the engine(s) is (are) operating.

HYGROSCOPIC—The ability to absorb and retain moisture.

ILLUSTRATED PARTS BREAKDOWN (IPB)—A manual containing illustrations and part numbers for all parts of the aircraft or equipment on which it is issued. The IPB contains information required for ordering parts, including stock numbers, and for identifying parts and arrangements of parts in assemblies.

IMPINGEMENT—A collision resulting in damage to a metallic surface or its protective coating. This localized condition can be manmade or environmental.

INCIDENT, AIRCRAFT—A mishap involving Navy aircraft that occurs when intent for flight exists and, if any damage to the aircraft occurs, does not exceed limited damage. (See the current edition of OPNAVINST 3750.6 Series further classification of aircraft accidents.)

INCIDENT, GROUND—An occurrence involving one or more aircraft not in operation, caused by windstorms, floods, or hanger fires, or from the operation of another aircraft (civil or military) not operating with intent for flight.

INDIVIDUAL EQUIPMENT—Referring to method of use, signifies personal clothing and equipment for the personal use of the individual. See Equipment.

INDIVIDUAL MATERIAL READINESS LIST (IMRL)—See Aircraft Maintenance Material Readiness List (AMMRL) Program.

INDUSTRIAL ESTABLISHMENT—Naval aeronautical productive establishments organized along industrial rather than military lines. These establishments are equipped to perform aircraft rework on a large scale and of extremely wide scope. They are also capable of performing limited manufacturing work. Only Naval and Marine Corps activities designated as Naval Air Rework Facilities are included in this explanation.

INHIBITOR—A chemical substance which decreases the ability of an electrolyte to conduct.

INITIAL OUTFITTING—The process of issuing, assembling, and delivering allowances of aeronautical material and equipment to vessels in any one of the following categories:

a. New construction

b. Conversion

c. Activating from reserve fleets. (See BUWEP-INST 4423.2 series.)

INITIAL OUTFITTING LISTS (IOL)—See Aeronautical Allowance Lists.

INITIAL PROVISIONING—The process of determining the range and quantity of items (e.g., spares and repair parts, special tools, test equipment, and support equipment) required to support and maintain an end item of material for an initial period of service. Its phases include the identification of items of supply; the establishment of data for catalog, technical manual, and allowance list preparation; and the preparation of instructions to assure delivery of necessary support items with related end articles. Follow-on provisioning (a subsequent provisioning of the same equipment from the same contractor) and reprovisioning (a subsequent provisioning of the same equipment from a different contractor) are refinements of initial provisioning and are distinct from replenishment or reprocurement actions.

INORGANIC COATING—A protective coating which is applied by electroplate, chemical conversion, anodize, phosphate, or oxide, etc.

IN-SHOP MAINTENANCE—Work that requires the use of shop facilities and that cannot be normally performed outside the shop. (Bench test and component disassembly and repair are examples of in-shop maintenance work.)

INSPECT—To compare the characteristics of an item with established standards.

INSPECTION—The examination and testing of supplies and services (including, when appropriate, raw materials, components, and intermediate assemblies) to determine whether they conform to specified requirements.

INSTRUCTIONS—Directives of a continuing nature that are effective until subsequently cancelled. Instructions employ a subject classification numbering system in accordance with the Navy Directives System.

INTERCHANGEABLE ITEMS—Two or more items that have such functional and physical characteristics as to be equivalent in performance and durability and capable of being interchanged without alteration of the items themselves or of adjoining items except for adjustment.

INTERGRANULAR CORROSION—A corrosion type which attacks along the grain boundaries of a metal.

INTERIM CHANGE—A change (see definition) having an action classification of Immediate or Urgent and issued in message or speedletter form.

INTERMEDIATE (I) LEVEL CALIBRATION—The calibration process performed by authorized Navy activities other than Navy Calibration or Standards Laboratories. "I" level calibration is accomplished by specially trained fleet personnel utilizing authorized calibration standards, equipment, and procedures. The calibration standards employed must be calibrated periodically by a calibration or standards laboratory. "I" level calibration is subject to the same close control as calibration performed in a Navy calibration or standards laboratory so that overall quality and accuracy of the precision measuring equipment can be maintained. See also Authorized Intermediate Level Calibration Training. Calibration, Intermediate Level Calibration Activity and Precision Measuring Equipment.

INTERMEDIATE LEVEL CALIBRATION ACTIVITY—A Navy activity other than a Navy Calibration or Standards Laboratory authorized by the type commanders and NAVAIR to perform calibration.

INTERMEDIATE MAINTENANCE—See Maintenance Levels.

INTERMEDIATE MAINTENANCE ACTIVITY (IMA) NAVY—Any activity (ship or station) authorized to perform intermediate maintenance. The IMA has an Aircraft Intermediate Maintenance Department (AIMD) as one Department.

INTERMEDIATE MAINTENANCE ACTIVITY (IMA) MARINE—That activity within a Marine Air Group assigned the mission of providing intermediate levels of maintenance to the squadrons of the entire group.

ION—An electrically charged atom or group of atoms.

ITEM—This term denotes any level of hardware assembly, i.e., system segment of a system, subsystem equipment, component part, etc. See also (or) Centralized Items, Common Item, Critical Item, End Item, Interchangeable Items, Preferred Item, Regulated Item, Repairable Item, Replacement Item, Standard Item, and Substitute Items.

ITEM OF SUPPLY—An item that is "recurrently used, bought, stocked or distributed" so that only one distinctive combination of letters or numerals, or both, identifies the same item throughout the DOD.

ITEMS PROCESSED—This term identifies the total number of times an action taken code is applied toward a work unit code.

JOB CONTROL NUMBER (JCN)—A 10- or 11-character alphanumeric number designed to assist in the control of work accomplished by an activity.

JULIAN DATE—The year and a numerical day of the year identified by four numeric characters. The first character indicates the year and the remaining three characters specify the day of the year (i.e., 9209 indicates the 209th day of 1979 or 28 July 1979). The standard U.S. Government calendar includes both Julian and Gregorian dates.

KIT—See Quick Engine Change, Parts Kits, and Parts Kit Codes.

LEVELS, MAINTENANCE—See Maintenance Levels.

LIFE CYCLES—The total life span of an aeronautical system commencing with the concept formulation phase and extending through the operational phase up to retirement from the inventory.

LISTS—See Aeronautical Allowance Lists, Aircraft Maintenance Readiness List, and Fleet Allowance List.

LOCAL PURCHASE—The function of acquiring a decentralized item of supply from sources outside the DOD. See also Purchase.

LOCAL REPAIR CYCLE ASSET (LRCA)—Formerly referred to as Rotable Pool assets. An LRCA is any repairable item in an activity's OSI (Fixed Allowance) for which local repair capability exists. An LRCA can be centrally stored in what formerly was referred to as a Rotable Pool and pool management techniques can be utilized. The difference is that there are no constraints on range and depths of LRCAs that can be stored in a central LRCA Storage Unit since all OSI repairables are carried in "W" Purpose Code. Storage of "W" Purpose Code repairable is at the discretion of the local Supply Officer.

LOGISTICS—The science of planning and carrying out the movement and maintenance of forces. For its most comprehensive sense, those aspects of military operations that deal with: (1) design and development, acquisition, storage, movement, distribution, maintenance, evaluation, and disposition of material; (2) movement, evaluation, and hospital inspection of personnel; (3) acquisition or construction, maintenance, operation, and disposition of facilities; and (4) acquisition or furnishing of services.

LOGISTICS SUPPORT—The materials and services required to enable the operating forces to operate, maintain, and repair the end item within the maintenance concept defined for that end item. Logistics support encompasses the identification, selection, procurement, scheduling, stocking, and distribution of spares, repair parts facilities, ground support equipment, trainers, technical publications, contractor engineering and technical services, and personnel training as necessary to provide the operating forces with the capability needed to keep the end item in a functioning status.

LOOK PHASE—The portion of an inspection that includes the basic requirements outlines by the Periodic Maintenance Information Cards, excluding repair of discrepancies that cannot be completed within the time alloted on maintenance requirements cards.

MACHINE RECORD—A collection of related data elements, in machine—sensible language, treated as a unit of information. In Maintenance Data Collection, a machine record is ordinarily in the form of a punched card or a segment of magnetic tape.

MAINTAINABILITY—The ability to maintain an item in, or restore to, a specific operational condition by expending resources, including man-hours of work and time, at an acceptable rate when using prescribed procedures and resources.

MAINTENANCE—The Department of Defense defines the term as follows: "Maintenance is the function of retaining material in, or restoring it to, a serviceable condition. Its phases include servicing, repair, modification, modernization, overhaul, rebuild, test, reclamation, inspection and condition determination, and the initial provisioning of support items." The term "maintenance" has a very general meaning, ranging from a matter of minutes of squadron servicing to a matter of months of industrial activity overhaul; the provision of maintenance material itself is within the meaning. The word "maintenance" should be qualified to convey a specific meaning. See Maintenance Type-Rework for distinctions in the scope of maintenance.

MAINTENANCE (MATERIAL)—

a. All actions taken to retain material in a serviceable condition or to restore it to serviceability. It includes inspection, testing, servicing, classification as to serviceability, repair, rebuilding, and reclamation.

b. All supply and repair actions taken to keep a force in condition to carry out its mission.

c. The routine recurring work required to keep a facility (plant, building, structure, ground facility, utility system, or other real property) in such condition that it may be continuously utilized at its original or designed capacity and efficiency for its intended purpose.

MAINTENANCE ACTION—Any one of a number of types of specific maintenance operations necessary to retain an item in or restore it to a specified condition.

MAINTENANCE ACTIVITY—Any organization (activity or unit) of the Naval Establishment assigned the mission, task, or functional responsibility of performing aircraft upkeep or rework. Use of the term refers to organizations and personnel occupying aircraft maintenance facilities and using aircraft maintenance material, but does not include reference to the facilities or material themselves. Aircraft maintenance activities are classified as to levels of maintenance performed. The highest level a particular activity is responsible for performing is established as that activity's classification. This classification does not necessarily mean that the activity involved is responsible for all lower levels of maintenance. See also Aviation Activity.

MAINTENANCE AND MATERIAL MANAGEMENT (3-M) SYSTEM—For aviation, the Maintenance Data System and Management Information System portion of the Naval Aviation Maintenance Program.

MAINTENANCE CODE—See Source, Maintenance, and Recoverability (SM&R) Codes.

MAINTENANCE CONCEPT—The planned or envisioned methods that will be employed to sustain the aeronautical system equipment at a defined level of readiness or in a specified condition in support of the operational requirement. This includes significant aeronautical system/equipment characteristics, e.g., built-in test, compatibility with existing or planned test and support equipments, etc., and a generalization of logistics support element requirements (manpower, equipment, facilities, workload distribution throughout the defined maintenance level, etc.). The maintenance concept is initially stated by the Government for design and support planning purposes and provides the basis or point of departure for development of the plan to maintain. The maintenance concept may be influenced or modified by economic technical or logistics considerations as the design development of the aeronautical system/equipment proceeds.

MAINTENANCE DEPARTMENT—That part of an activity responsible for the activity's aircraft maintenance functions; also considered a maintenance activity. In the Shore Establishment, stations responsible for intermediate maintenance will have maintenance departments. See Maintenance Division/Branch.

MAINTENANCE DEPTHS—Refers to the complexity or extensiveness of aircraft maintenance functions, e.g., the extent of disassembly, the complexity of a test, etc. Generally, the higher the level of maintenance, the greater the depth of maintenance involved.

MAINTENANCE DETACHMENT—The part of an aircraft maintenance activity that is geographically separated from but administered by the parent activity.

MAINTENANCE DIVISION/BRANCH—That part of an activity responsible for the activity's aircraft maintenance functions; or that part of an aircraft maintenance department responsible for a specific part of that department's functions, e.g., power plant, airframe, etc., or VF, VA, etc. In the Shore Establishment, stations responsible for only intermediate and organizational maintenance will have maintenance divisions of operations or air departments. See Maintenance Department.

MAINTENANCE ENGINEERING—That activity of equipment maintenance that develops concepts, criteria, and technical requirements during the conceptual and acquisition phases to be applied and maintained in a current status during the operational phase to assure timely, adequate, and economic maintenance support of weapons and equipments. See Maintenance Management.

MAINTENANCE ENGINEERING ANALYSIS (MEA)—The composite analytical studies, decisions, and related documentation conducted in connection with the design of an item to determine or influence the maintainability and reliability characteristics of the item and to determine the total support requirements resulting from the design. For new items, the analysis is conducted concurrently with the design process. For existing or off-the-shelf-items, the analysis is conducted as required to determine the characteristics and resulting support requirements.

MAINTENANCE ENGINEERING MANAGEMENT—The process of planning, organizing, staffing, directing, monitoring, and controlling those maintenance resources engaged in the engineering and technical support of equipment-maintenance. See Maintenance Engineering.

MAINTENANCE FACILITY—Any building, property, or space designed for, available to, or used by aircraft maintenance activities. Use of the term refers to shops, hangars, parking areas, etc.; both afloat and ashore; used primarily for aircraft upkeep or rework purposes. Use of the term does not refer to the organizations, personnel, responsibilities, or material (except installed aircraft support equipment). Aircraft maintenance facilities are classified by the levels of maintenance they are designed for or used to support. The highest level is established as that facility's classification. The classification does not necessarily indicate that the facility involved includes facilities for all the lower levels of maintenance. See Maintenance Facility Module.

NOTE

> The term "aircraft maintenance facility" includes installed aircraft support equipment when applied to Navy facilities. When applied to Marine Corps facilities, it does not.

MAINTENANCE FACILITY MODULE—Standard design increments of aircraft maintenance facilities that permit the construction of a facility without additional design other than that of site adaptation and orientation. There will be two standard modules for use within the Naval Establishment—Intermediate and Organizational—as required by the functional responsibility of the aircraft maintenance activity or activities that will be the tenant(s) of the facility involved.

MAINTENANCE FUNCTIONS—A detailed statement of the aircraft maintenance work of each aircraft maintenance level. Maintenance functions stem from maintenance tasks, are assigned by NAVAIR, and are classified as to the aircraft maintenance levels to which they apply.

MAINTENANCE INSTRUCTIONS—A numbered, letter-type directive issued internally by the maintenance department, division, or section to furnish information and/or require compliance.

MAINTENANCE INSTRUCTIONS MANUAL—A manual containing instructions for intermediate and organizational level servicing and maintenance of a specific model aircraft. Identifies each maintenance task to the responsible maintenance level. Issued for newer aircraft models instead of Handbook of Maintenance Instructions (see above).

MAINTENANCE LEVELS—Maintenance tasks divided into the number of levels required to maximize the common standards that can be applied to the many and varied aircraft maintenance activities of the military establishment. They are the modular increments of which all maintenance activities are composed. JCS PUB-1 defines three levels of maintenance—Depot, Intermediate, and Organizational:

a. Depot Maintenance—That maintenance performed on material requiring major overhaul or a complete rebuild of parts, assemblies, subassemblies, and end items, including the manufacture of parts, modifications, testing, and reclamation as required. Depot maintenance serves to support lower categories of maintenance by providing technical assistance and performing that maintenance beyond the responsibility of Organizational and Intermediate maintenance levels. Depot maintenance provides stocks of serviceable equipment by using more extensive facilities for repair that are available in lower level maintenance activities. (Level 3 maintenance.)

b. Intermediate Maintenance—That maintenance which is the responsibility of and is performed by designated maintenance activities for direct support of using organizations. Its phases normally consist of calibration, repair, or replacement of damaged or unserviceable parts, components, or assemblies, the emergency manufacture of nonavailable parts; and the provision of technical assistance to using organizations. (Level 2 maintenance.)

c. Organizational Maintenance—That maintenance which is the responsibility of and is performed by a using organization on its assigned equipment. Its phases normally consist of inspecting, servicing, lubricating, adjusting, and replacing parts, minor assemblies, and subassemblies. (Level 1 maintenance.)

MAINTENANCE MANAGEMENT—See Equipment Maintenance Management, Maintenance Engineering Management, Maintenance Production Management, and Management.

MAINTENANCE PERFORMANCE DATA—Data relating to the use and application of the work-force, industrial equipment, and dollars to sustain weapons and end item equipments in an operational status.

MAINTENANCE PERSONNEL—Personnel responsible for the administration, management, coordination control, or actual performance of aircraft maintenance functions.

MAINTENANCE PLANNING—The design, method, or scheme for accomplishing an aircraft mission of reaching an aircraft maintenance objective or objectives.

MAINTENANCE PROCEDURES—Established methods for periodic checking and servicing of items to prevent failure or to effect a repair.

MAINTENANCE PRODUCTION—That activity of equipment maintenance involving the physical performance of those actions and tasks attendant to the equipment maintenance function for servicing, repairing, testing, overhaul, modification, calibration, modernization, conversion, inspection, etc. The accomplishment of these tasks is normally carried out at the three levels—organizational, intermediate, and depot maintenance. See Maintenance Production Management.

MAINTENANCE PRODUCTION MANAGEMENT—The process of planning, organizing, and controlling organic industrial resources engaged in the physical performance of equipment maintenance. See Maintenance Production.

MAINTENANCE PROJECT—The master plan for the accomplishment of maintenance work on assigned and/or supported aircraft. It comprises the system of screening directives for applicability, preparing instructions, scheduling and performing routine and special maintenance work, and keeping the necessary records of work accomplished.

MAINTENANCE QUALITY ASSURANCE—The actions by which it is determined that material maintained, overhauled, rebuilt, modified, and reclaimed conforms to the prescribed technical requirements. See Audit and Quality Assurance.

MAINTENANCE REQUIREMENTS CARDS (MRC)—Sets of cards issued by NAVAIR containing scheduled maintenance requirements applicable to intermediate and organizational level activities for the specific aircraft/GSE for which they are issued. (See Periodic Maintenance Information Cards.)

MAINTENANCE RESOURCES—Personnel, materials, tools and equipment, facilities, technical data, and dollars provided to carry out the equipment maintenance mission.

MAINTENANCE SCHEDULE—Planning the procedure for carrying out specific jobs or projects in a maintenance activity's maintenance program; fixing the time when operations are to be begun or completed.

a. Crew Scheduling—Scheduling within crews.

b. Detailed Scheduling—Planning, to crew or shop level, the procedure that carries out a program schedule by a specific crew, shop, or particular group of crews or shops.

c. Master Scheduling—The development of a department division, or section workload plan for the output needed, by programs (Aircraft, aircraft equipment, or aircraft support equipment), to meet requirements.

d. Program Scheduling—Planning the procedure for carrying out a program of the master schedule; fixing the time when operations or jobs are to be begun or completed by crews or shops.

e. Shop Scheduling—Scheduling within a shop.

MAINTENANCE SQUADRON—That activity or unit within a Marine Air Group assigned the mission of providing intermediate levels of maintenance to the squadrons of the entire Group.

MAINTENANCE STATUS—The classification or condition of equipment undergoing preventive/restorative action.

MAINTENANCE TASK—Those incremental-maintenance elements performed by maintenance personnel in completing a maintenance action.

MAINTENANCE TYPES—There are two basic types of aircraft maintenance performed within the Naval Establishment without distinction as to levels of maintenance—Rework and Upkeep, Rework is pertormed only in the Shore Establishment. It may be performed on any program aircraft ("operating" or "nonoperating"), aircraft equipment, or aircraft support equipment. It is performed only by industrial type activities assigned the mission, task, or functional responsibility of providing maintenance program support. Rework is performed with both military and civilian personnel and is managed by NALC. Upkeep is performed only on "operating" aircraft, aircraft equipment, or aircraft support equipment. It is performed by military type activities that are assigned aircraft or equipment or assigned the mission, task or functional responsibility or providing direct support to such activities. Upkeep is normally performed with military personnel and is managed by major operating commands.

a. Rework—The restorative or additive work peformed on an aircraft, aircraft equipment, and aircraft support equipment by Naval Air Rework Facilities, contractors' plants, and such other Industrial Establishments designated by type commanders. A Rework process extends from the time some of the work is started until all of the work has been completed, including temporary interruptions in direct labor, it also includes Rework evaluation and test and correction of discrepancies determined thereby. Rework is divided into two categories, standard and special.

1. Standard Depot Level Maintenance (SDLM)—A comprehensive depot level inspection of selected aircraft structures and materials, correction of critical defects, incorporation of technical directives and limited removal/overhaul of SRC items.

2. Special Rework—The work done to aircraft, aircraft equipment and aircraft support equipment to improve or change their capability to perform specific missions or functions by replacement, removal, addition, alteration, or repair of parts on equipment of the aircraft. Special Aircraft Rework includes the following types of rework:

(a) Modernization—Special Rework performed on new or newly overhauled aircraft withdrawn from storage. It includes incorporation of applicable changes and bulletins, installation of acceptable accessories, and flight testing.

(b) Modification—Special Rework accomplished on new production aircraft and aircraft in the controlling custody of the Operating Commands. It includes only the incorporation of changes and bulletins and the correction of discrepancies as required in the directive authorizing the work to be performed. In effect, the only basic difference between Modernization and Modification is that the former applies to aircraft withdrawn from storage while the latter does not.

(c) Conversion—Rework which alters the basic characteristics of the aircraft to such an extent as to effect a change in any part of the model designation (e.g., F-4B, F-4N).

(d) Pilot Rework—Rework of selected items by government activities, during both the preoperational and operational program to establish overhaul/repair capability for selected components of the aeronautical system, ground support equipment, training equipment and trainers.

(e) Analytical Rework—Complete disassembly, inspection, engineering evaluation, repair, assembly, and test of commercial derivative Navy aircraft, for defining the depot level maintenance requirements.

(f) Inservice Repair—Repair by NAVAIR Fleet Support (FS) activities of aircraft damaged beyond the repair capability of controlling custodian maintenance activities. Controlling custody remains unchanged between or during the changes in physical custody. Inservice repairs are Special Rework, and the aircraft will undergo the entire rework process of the NAVAIR FS activity concerned unless specific exceptions are requested by the controlling custodian.

(g) Interservice Rework—The rework of aircraft belonging to one service utilizing the rework resources of another (e.g., Army rework of Navy owned H-1 helicopters).

(h) Repair—Special Rework accomplished to correct material damage and to restore the aircraft to the equivalent material condition it had before the damage was sustained. Aircraft may be in the controlling custody of either an Operating Command or NAVAIR FS while undergoing repair.

b. Upkeep—The preventative, restorative, or additive work performed on aircraft, aircraft equipment, and aircraft support equipment by operating units and by aircraft support equipment activities. The term applies to any method of processing aircraft required to ensure the completion of standard operating periods or service tours, including, but not limited to, servicing, periodic inspections, functional and bench test, replacement, preservation, modification, and repair. An Upkeep process extends from the time some of the work is started until all the work is completed, including temporary interruptions in direct labor; it also includes upkeep evaluation test and correction of discrepancies determined thereby. Upkeep is divided into two categories, Standard and Special.

1. Standard Upkeep—The periodic or scheduled work performed on aircraft, aircraft equipment, and aircraft support equipment after (and as a result of) completion of a prescribed number of flying hours, operating hours, or calendar days in accordance with prescribed inspection or replacement requirements and such that the end product requirement of the work includes the capability of aircraft or equipment to serve a full prescribed period of flying hours, operating hours, or calendar days before undergoing Upkeep again. The distinction between Standard Upkeep and Special Upkeep is: Standard Upkeep is an integral part of the prescribed operating period or service tour, such as the upkeep always done during operating periods after a prescribed number of flying hours, operating hours, or calendar days (scheduled). Special Upkeep is the result of a need or desire that may arise any time and without regard to flying hours, operating hours, calendar days, or operating periods (unscheduled). Standard Upkeep includes, but is not limited to, daily, special, calendar, phase inspection and scheduled replacement, functional, or bench test.

2. Special Upkeep—The work done to aircraft, aircraft equipment, and aircraft support equipment to improve, change, or restore their capability to perform specific missions or functions by replacement, removal, addition, alteration, or repair of parts of equipment of aircraft, without particular regard to flying hours, operating hours, calendar days, or operating periods. Special Upkeep includes, but is not limited to, modification, repair, and unscheduled inspection, replacement, or test.

MAJOR ENGINE INSPECTION—A comprehensive inspection performed to determine the material condition of the engine. This inspection is often performed with the engine removed from the aircraft but may be accomplished on certain installed engines using a borescope.

MANAGEMENT—A general term to denote central executive direction and control of a work effort by an individual or organization entity that is specifically assigned to accomplish the function and is provided appropriate resources.

MANAGEMENT AUDIT—A period assessment of a command's managerial planning, organizing actuating, and controlling compared to what might be the norm of successful operation. Management auditors do not appraise individual performance. See also Audit.

MANAGEMENT INFORMATION SYSTEM—Techniques, either manual or automated, that make information available to all echelons of management upon which to base management decisions.

MAN-HOURS—The total number of accumulated direct labor hours (in hours and tenths) expended in performing a maintenance action. The various man-hour categories are:

a. Assigned Man-hours—Hours assigned to a work center; equals the number of personnel assigned times the number of working days in a specified period times eight hours per day.

b. Available Man-hours—Hours actually assigned to a work center during a reporting period; equals original assigned man-hours plus newly and temporarily assigned man-hours less transferred and temporarily transferred man-hours, plus overtime man-hours.

c. Newly Assigned Man-hours—Hours gained by permanent assignment of personnel to a work center during a reporting period.

d. Original Assigned Man-hours—Hours projected (at the beginning of a reporting period) for availability during the reporting period; normally based on a 5-day, 40-hour week.

e. Temporarily Assigned Man-hours—Hours gained by temporary assignment of personnel to a work center for a period in excess of three-tenths of an hour reporting period.

f. Temporarily Transferred Man-hours—Hours lost due to temporary transfer of personnel from a work center for a period in excess of three-tenths of an hour during a reporting period.

g. Transferred Man-hours—Hours lost by permanent transfer of assigned personnel from a work center during a reporting period.

MANUALS—See Handbook, Illustrated Parts Breakdown, Maintenance Instructions Manual. Naval Air Training and Operating Procedures Standardization (NATOPS) Manual, Periodic Maintenance Requirements Manual.

MANUFACTURER—An individual, company, firm, corporation, or Government activity engaged in the fabrication of finished or semifinished products.

MANUFACTURER'S IDENTIFICATION—The actual manufacturer's name, registered trademark, or code identification.

MANUFACTURER'S PART NUMBER—See Reference Number.

MASTER REPAIRABLE ITEM LIST (MRIL)—A listing in National Identifications Item Number (NIIN) sequence of all repairable assemblies, including local repairable assemblies, indicating the Designated Overhaul Point (DOP) (Navy or commercial) and providing shipping instructions for these assemblies when they become defective. This list is published as NAVSUP PUB 4107.

MASTER ROSTER DECK—Consists of those punched cards that remain in the possession of data services and from which the master roster listing is prepared.

MASTER ROSTER LISTING—A complete listing, by organization and work center, of all personnel assigned for the reporting period by name, grade, code, pay rate, social security number NEC/MOS (NOBC may be used for officers), labor code and assigned hours.

MASTER SCHEDULING—See Maintenance Schedule.

MATCHED SET—A group of two or more separate components that function together in a single system and are normally removed, repaired, checked, adjusted, calibrated, and installed together. Replacement of a single component of a matched system normally requires check, adjustment, and/or calibration of the matched set.

MATERIAL—All items necessary for the equipment, maintenance, and support of military activities without distinction as to their application for administrative or combat purposes, excluding ships or naval aircraft. See also Equipment, Division of.

MATERIAL COGNIZANCE—Denotes responsibility for exercising supply management over items or categories of material. See also Cognizance Symbols and Cognizant NAVAIR Representatives.

a. 2R Cognizance Material—Aeronautical items in material control codes D, E, H, and X over which the Aviation Supply Office (ASO) exercises complete supply management.

b. 8R Cognizance Material (formerly 2V)—Aeronautical material over which NAVAIR exercises supply management, but for which NAVAIR has delegated certain inventory control responsibilities to ASO.

MATERIAL CONDITION CODE—A single alphabetic character that identifies that condition of material. It provides the means of segmenting and identifying on the inventory control record the physical state of the material of actions underway to change the status of the material. (NAVSUP PUB 437.)

MATERIAL CONTROL—See Inventory Control.

MATERIAL CONTROL CODE—A single alphabetical character used within the Naval Supply System to identify repairable items that require special management. Characters utilized are D, E, G, H, Q, or X. (NAVSUP 4000.)

MATERIAL CONTROL REGISTER—A register established to record all requisitions for material that are passed to the SSC (i.e., for which the SSC will prepare the required requisitions).

MATERIAL REPORTING—The procedure whereby all supply action documents in support of maintenance are keypunched and mailed to the central data bank in Mechanicsburg, Pennsylvania, where the information is accumulated, summarized, and reported to top management.

MATERIAL REQUIREMENTS—Those quantities of items of equipment and supplies necessary to equip, provide a material pipeline, and sustain a service, formation organization, or unit in the fulfillment or its purpose or tasks during a specified period. (JCS PUB-1.)

METALLIZING—A process of coating a base metal with a layer of another metal.

METER READING—Meter readings, as used in this manual, apply to only those items that have a clock/meter installed. Readings will be in time, cycles, starts, etc., to the nearest whole number. Recording of meter readings will be prefixed with a letter M.

METROLOGY—The science of measurement of determination of conformance to technical requirements, including the development of standards and systems for absolute and relative measurements. See also Calibration, Metrology Automated System for Uniform Recall and Reporting, Metrology Requirements Listing.

METROLOGY AUTOMATED SYSTEM FOR UNIFORM RECALL AND REPORTING (MEASURE)—A Metrology Automated System for Uniform Recall and Reporting of test equipment by means of automatic data processing techniques. This system maintains records of calibration and automatically recalls items when due for recalibration.

METROLOGY REQUIREMENTS LISTING (METRL)—A NAVAIR publication (NAVAIR 17-35MTL 1) that provides test equipment information regarding part number, nomenclature, manufacturer's code, calibration procedures, and calibration intervals.

MICROFORM—A generic term, for any form, whether film, or other medium, containing miniaturized or otherwise compressed optical images which cannot be read without special display devices.

MIL—One one-thousandths of an inch (0.001"). Used to express paint coating thickness, surface preparation and corrosion damage.

MILITARY STANDARD REQUISITIONING AND ISSUE PROCEDURE (MILSTRIP)—A uniform procedure established by DOD for its own use to govern requisition and issue of material within standard priorities. (JCS PUB-1.)

MILITARY STANDARD TRANSACTION REPORTING AND ACCOUNTING PROCEDURES (MILSTRAP)—The Military Standard Transaction Reporting and Accounting Procedure enlarges upon MILSTRIP by extending uniform communicating procedures, codes, forms, and formats for the transmission of items and financial inventory data between the management, stock control, and storage elements of military service/Defense Supply Agency distribution systems. (NAVSUP PUB 437.)

MINOR DEFECTS—See Defects.

MISSION—

a. The objective; the task together with the purpose, which clearly indicates the action to be taken and the reason therefore.

b. In common usage, especially when applied to lower military units, a duty assigned to an individual; a task.

c. The dispatching of one or more aircraft to accomplish one particular task. (JCS PUB-1.)

MISSION CAPABLE (MC)—See Readiness Reporting Terms and Definitions.

NATIONAL STOCK NUMBER (NSN)—It is the 13-digit stock number consisting of the four-digit Federal Supply Classification (FSC) code, and the nine-digit National Item Identification Number (NIIN). Component segments of the NSN 5330-00-123-4567 are identified as follows:

a. Federal Supply Classification (FSC) 5330

b. National Codification Bureau (NCB) code 00

c. National Item Identification Number (NIIN)-00-123-4567

d. National Stock Number (NSN) 5330-00-123-4567

NAVAL AIR MAINTENANCE TRAINER (NA-MTRA)—A transportable instructional equipment unit designed to provide training support for a weapon system, a specific equipment, a group of related equipments, or specialized techniques. (OPNAVINST 1540.2 series.)

NAVAL AIR MAINTENANCE TRAINING DETACHMENT (NAMTRADET)—A group of instructors equipped with Naval Air Maintenance Trainer(s), training aids, lesson guides, and training literature. (OPNAVINST 1540.2 series.)

NAVAL AIR MAINTENANCE TRAINING GROUP (NAMTRAGRU)—A commissioned activity under the Military Command of the Chief of Naval Air Technical Training, and under the management control of the Commander, Naval Air Systems Command, responsible for providing by means of Naval Air Maintenance Training-Detachments, technical training for officers and enlisted personnel in the operation, maintenance, and repair of air weapons systems and associated equipment and for conducting such other training as the CNO may direct. (OPNAVINST 1540.2 series.)

NAVAL ESTABLISHMENT—Comprises the Navy Department, Shore Establishment, and the Operating Forces (both civilian and military components), synonymous with the term "Department of the Navy."

NAVY DEPARTMENT—One of the three principal parts of the Naval Establishment consisting of Offices, Systems Commands, etc., located in Washington, D.C., which maintain policy control, command, administrative, and logistic direction of the Navy. Department of the Navy on the other hand, is synonymous with the term: "Naval Establishment."

NAVY DIRECTIVES SYSTEMS—Consists of instructions and Notices employing the subject classification numbering system for identification and filing purpose. (Ref: SECNAV Instruction 5215.1 series.) The system is used throughout the Navy for issuing directives on policy, organization, and administrative methods or procedures.

NAVY SUPPORT DATE (NSD)—The date on which the Navy assumes full support responsibility for a weapon system. Under certain conditions this full support responsibility may exclude peculiar equipments and/or assemblies (as directed by NAVAIR) from the Navy support responsibility for a fixed period of time. During this period, these peculiar equipments and/or assemblies remain under contractor support.

NAVY TYPE NUMBER—A specific number constructed for a particular item from a general Navy specification.

NITRATES—Compounds containing nitrogen. Salt or ester of nitric acid often present in industrial pollutants.

NOBLE METALS—Metals such as gold, silver and platinum which do not readily corrode. Also considered to be the less active of two dissimilar metals in the Galvanic Series.

NONDESTRUCTIVE INSPECTION (NDI)—Those methods that may be applied to a structure of component to determine its integrity; composition; physical, electrical, or thermal properties; or dimensions without causing a change in any of these characteristics. The NDI methods in existence at this time are:

a. Visual or Optical Inspection is the oldest, cheapest and simplest of nondestructive tests. The human eye, with such aids as microscopes and borescopes, is an easily believed instrument. Most inspections, whether destructive or nondestructive, end with a visual assessment of the results.

b. Penetrant Nondestructive Inspection—Methods that are used for the detection of surface cracks or discontinuities, whereby the inspection surfaces are sprayed with or immersed in liquid. The excess liquid is removed, and the defect is indicated visually by color or fluorescence.

c. Eddy Current Nondestructive Inspection—Methods that use induced eddy current in detecting flaws in metal parts, such as cracks, inclusions, voids, seams, laps, etc. This method can also be used for sorting according to alloy temper, conductivity, and other metallurgical factors by variations in electrical characteristics and/or energy losses.

d. Magnetic Particle Nondestructive Inspection—Methods that use magnetic fields for the purpose of detecting fine discontinuities at or near the surface of the part. This method is limited to ferromagnetic materials.

e. Ultrasonic Nondestructive Inspection—Methods that use ultrasonic energy to inspect parts of structures for defects, thickness variations, corrosion, fluid leaks, etc; the absorption of ultrasonic energy by the object is observed to determine discontinuities or measuring thickness. This method can be applied to metallic or nonmetallic materials.

f. Radiographic Nondestructive Inspection—Methods that use X-ray or similar radiation for the purpose of penetrating or being scattered by substances to reveal flaws or defects in the part or structure being examined.

NONOPERATING AIRCRAFT—Any aircraft not currently filling an authorized allowance in an organizational unit for the purpose of flight operations. See Operating and Operational Pool.

NORMAL REPAIR—Repairs found necessary during calibration of an operable equipment to bring it within its specified tolerances, including the replacement of parts that have changed value sufficiently to prevent calibration but do not otherwise render the equipment inoperative. This repair work is normally performed incidental to the calibration of precision measuring equipment or calibration standards.

NOTICES—Directives of a one-time nature or those applicable for a brief period of time. Each notice contains provisions for its own cancellation. Notices employ a subject classification numbering system and are part of the Navy Directive System.

NUMERICAL INDEX—Part of the Naval Aeronautical Publications Index, NAVSUP 2002, Section 8, Parts C and D, listing NAVAIR distributed publications by numerical arrangement of publication numbers. Also, in an Illustrated Parts Breakdown, the numerical listing by part number; normally the last section of the IPB. See Provisioning and Publication Index.

OBSOLETE (EQUIPMENT)—See Equipment Classification.

OFF-EQUIPMENT WORK—For the purpose of Maintenance Data Reporting, includes all maintenance actions performed on removed repairable component (usually at the intermediate maintenance activity).

ON-EQUIPMENT WORK—For the purpose of Maintenance Data Reporting, includes those maintenance actions accomplished on complete end items (i.e., aircraft, drones, aircraft ground support equipment units, removed engines, etc.).

ON-SITE CALIBRATION—Calibration service performed at the customers activity by calibration personnel for test items in the following categories:

a. Nonportable—Items of precision measuring equipment that cannot be feasibly transported to a calibration installation.

b. Sensitive—Test PME having inherently sensitive measurement parameters that become uncalibrated due to handling and shipping.

OPERABLE EQUIPMENT—An equipment—which, from its most recent performance history and a current cursory electrical and physical examination, displays an indication of satisfactory performance for all of its functions.

OPERATING BUDGET—The annual budget and financial authority of an activity or command containing the resources to perform its mission. Type commanders subdivide expense limitation into various operating budgets. Some operating budgets are retained by the type commander (e.g., those operating budgets used to fund ships' OPTARs) and others are issued directly to lower levels of command (e.g., shore activities).

OPERATING COMMAND—A Controlling Custodian of Navy aircraft, except NAVAIR FS. Also called Air Command or Major Operating Command. (See "Controlling Custodian" in Part II or OPNAVINST 5442.2 series for specific designations of Operating Commands.) See Controlling Custodian.

OPERATING FORCES—Those forces whose primary missions are to participate in combat and the integral supporting elements thereof. (JCS PUB-1.)

OPERATING TARGET (OPTAR)—Operating budget holders will establish OPTARs as required to separately identify costs and to permit command and management to follow the same channels. OPTARs will not be issued from other operating targets, but will be issued direct from an operating budget holder down through one or more levels in the command structure. Operating targets are not designated with a distinguishing identification number. The combination of the Service Designator ("R" for Pacific Fleet units and "V" for Atlantic Fleet units), unit identification code of the operating target holder, and the fund code applicable to the operating budget provides the complete accounting classification.

OPERATING UNIT—Squadrons and units with an operating allowance listed in the "Allowances and Location of Navy aircraft" (Blue Book). Squadrons and units may be further subdivided into detachments. To be "operating," a unit must have a mission that requires flight operations (other than ferry flight test) by Navy aircraft (OPNAVINST 5442.2 series).

ORGANIC COATING—A coating composed of matter derived from hydrocarbons. Paints, lacquers, plastic, grease, preservatives, etc.

ORGANIZATIONAL EQUIPMENT—Referring to method of use, signifies that equipment, other than individual equipment, use in furtherance of the common mission of an organization or unit.

ORGANIZATIONAL MAINTENANCE—See Maintenance Levels.

OVERHAUL—The process of disassembly sufficient to inspect all the operating components and the basic end article, followed by repair, replacement, or servicing as necessary, followed by reassembly and bench check/flight test. Upon completion of the overhaul process, the component/end article will be capable of performing its intended service life/service tour. See Maintenance Types.

OVERTIME—Hours expended during a specified period in excess of a standard based on a 40-hour week (8 hours per day, 5 days per week).

OXIDATION—Process of electron loss and chemical alteration associated with the corrosion of the anode.

PACKAGING—An all-inclusive term covering, cleaning, preserving, packaging, packing, and marking required to protect items during every phase of shipment, handling, and storage (NAVSUPINST 4030.28 Series).

PARTS KIT—Supporting items and material for the maintenance, repair and rework of selected aeronautical repairable-type end items will be procured, stocked, requisitioned, accounted for, and used on a kit basis as one line item. Items included in Parts Kits will be coded in accordance with the definitions outlined in NAVAIRINST 4423.2 series. Parts Kits should not be confused with kits issued to perform a one-time modification of an item or with Interim Fleet Maintenance Support Kits. (See NAVAIRINST 4423.2 series for further clarification.)

PARTS KIT CODES—Codes assigned to parts kits, and items therein, for the maintenance, repair, and rework of selected repairable-type end items. (See NAVAIRINST 4423.3 series for further explanation and codes.) See Provisioning and Source, Maintenance, and Recoverability (SM&R) Codes.

PASSIVATION—A process whereby a metal become inert or neutral to the corrosive environment.

PECULIAR GROUND SUPPORT EQUIPMENT—See Ground Support Equipment.

PERIODIC MAINTENANCE INFORMATION CARDS (PMIC)—The PMS publication that contains the component removal/replacement schedule and scheduled removal component card requirements covering organizational and intermediate level maintenance. It also contains a maintenance reference table specifying those directives which have been incorporated in the PMS publications since the last routine change or revision.

PERMANENT UNIT CODE (PUC)—A six-character number permanently assigned to each reporting custodian of aircraft. The master list of Permanent Unit Codes is maintained by CNO (OP-511). PUCs may be obtained from CNO by the cognizant controlling custodian for assignment to newly formed units by correspondence, message, or AUTOVON telephone call. (See OPNAVINST 5442.2 series for further clarification.)

PITTING CORROSION—Formation of small cavities on a metallic surface caused by chemical or physical nonhomogeneities.

PERSONNEL—Those individuals required in either a military or civilian capacity to accomplish the assigned mission. See Maintenance Personnel.

PERSONNEL QUALIFICATION STANDARDS (PQS)—PQS is a document which describes the knowledge and skills a trainee must have to correctly perform his duties. The policy and procedures for PQS are outlined in OPNAVINST 3500.34 series.

PETROLEUM, OIL AND LUBRICANT (POL)—A broad term that includes all petroleum and associated products used by the Armed Forces. (JCS PUB-1.)

PHYSICAL CUSTODY—See Custody.

PLANNING MAINTENANCE—See Maintenance Planning.

PLANT PROPERTY—Capital assets used in the production of goods and services, but excluding material consumed in producing them (DODDIR 5000.6).

POLYETHYLENE—A thermal plastic characterized by high strength, electrical resistance, and nontoxicity.

POT LIFE—An amount of time during which a mixed compound will perform as designed.

PRECISION MEASURING EQUIPMENT (PME)—All devices used to measure, gage, test, inspect, diagnose or otherwise examine material supplies, and equipment to determine compliance with requirements established in technical documents (e.g., RDT&E documents, specifications, engineering drawing, technical orders, technical manuals, maintenance instructions, and serviceability standards).

PREEXPENDED BIN—One that contains only low cost, high usage items previously charged to final expenditure. It will be replenished from stocks in the retail outlet that supports the shop in which the preexpended bin is located (NAVSUP Manual, Paragraph 25612).

PRESERVATION—Work done on an aircraft in accordance with NAVAIR specifications for program aircraft. The work depend on the expected period of idleness. See Maintenance Types.

PREVENTIVE MAINTENANCE—The care and servicing needed to maintain equipment and facilities in satisfactory operating condition by providing for systematic inspection, detection, and correction of incipient failures either before they occur or before they develop into major defects.

PRIME MOVER—A vehicle, including heavy construction equipment, possessing military characteristics, designed primarily for towing heavy, wheeled weapons, and frequently providing facilities for the weapons's crew and ammunition (JCS PUB-1).

PRIME COAT—The first coat of a paint system. Applied to improve the adherence of successive coats. Often contains a corrosion inhibitor.

PROCESS—A generic term used to describe the series of actions or uses an aircraft is subjected to as it progresses through its Service Life. Six broad categories are included in the term: Operating, SDLM, Special Rework, Storage, Retirement and Strike, and Miscellaneous, Sudivisions are included under each category to describe specifically the action of use involved. (See Aircraft Status Code in OPNAVINST 54442.2 series.)

PROCUREMENT—The process of obtaining personnel, services, supplies, and equipment.

PRODUCTION—The conversion of raw material into products and/or components thereof through a series of manufacturing processes. It include functions of production engineering, controlling quality assurance, and the determination of resources requirements (JCS PUB-1).

PRODUCTION CONTROL—The functional organization within the AIMD/IMA responsible for the overall workload control.

PRODUCTION DIVISION—Any division in intermediate maintenance that is responsible for specific production workload, e.g., avionics power plants, etc.

PROGRAM MANAGEMENT—A general term describing the overall management of a program that involves the coordination of all aspects of several specifically related projects/programs (i.e., aircraft engine programs) and that requires a central source of coordinated management information. A management charter will be provided for program management, which will be used on an exceptional basis.

PROPERTY—

a. Anything that may be owned.

b. As used in the Military Establishment, this term is usually confined to tangible property, including real estate and material.

c. For special purposes and as used in certain statutes, this term may exclude such items as the public domain, certain lands, certain categories of naval vessel, and records of the Federal Government. (JCS PUB-1.)

PROVISIONING—The principal objectives of provisioning are to (1) accomplish the technical planning to establish the item support plan piece by piece and assembly by assembly, (2) establish the minimum levels/echelons responsible for repair, (3) fix the kind and type of support equipment requirements of handbooks, manuals, and other maintenance publications, (4) determine the basic factory and field training requirements; and (5) provide for the establishment of inventory management records. See Initial provisioning.

PUBLICATION INDEX (Naval Aeronautic Publications Index)—A listing of NAVAIR manual and letter publications in six parts:

a. NAVSUP 2002 Section 8, parts C and D—Numerical Sequence List.

b. NAVAIR 00-500A—Equipment Applicability List.

c. NAVAIR 00-500B—Aircraft Application List.

d. NAVAIR 00-500C—Directives Application List.

e. NAVAIR 00-500M—Microfilm Cartridge Cross Reference.

f. NAVAIR 00-700-Airborne Weapons/Stores, Conventional/Nuclear, Checklist/Stores Reliability Cards/Manual.

PURCHASE—To procure property or services for a price; includes obtaining by barter. (JCS PUB-1.) See also Collaborative, Joint, Local, and Single Department Purchase.

QUALITY ASSURANCE (QA)—A planned and systematic pattern of all actions necessary to provide adequate confidence that the item or product conforms to established technical requirements. See also Maintenance Quality Assurance and Audit.

QUALITY CONTROL (QC)—A management function whereby control of the quality of raw or produced material is exercised for the purpose of preventing production of defective material.

QUICK ENGINE CHANGE (QEC)—

a. Quick Engine Change Assembly (QECA)—A quick engine change kit completely assembled on a quick engine change stand with the engine and all accessories, less the propeller for reciprocating engines.

b. Quick Engine Change Kit (QECK)—A kit containing all items required for a QECA less Government furnished equipment (GFE), engine, and propeller. Contractor furnished accessories may be deleted subject to approval by NAVAIR when storage limitations bulk, or their general nature warrant such deletion. The kit, as delivered, will be assembled, as far as practical, compatible with packaging limitations.

c. Quick Engine Change Stand (QECS)—A structural frame, equipped with castors and floor locks, on which a QECA may be mounted.

READY FOR ISSUE (RFI) MATERIAL—Material which does not require rework of any type, replacement for overage parts, or other than routine pre-installation and post-installation condition verification prior to operational use. RFI items are not necessarily new or like new but are functionally reliable and meet applicable performance specifications. Packaging and preservation do not enter into the process of producing an RFI item, but are required in order to maintain the item identity and condition and to prevent damage during subsequent shipping, handling and storage.

REDUCTION—A process of collecting or gaining electrons in a corrosion cell. Associated with the cathode.

RECOVERABILITY CODES—See Source, Maintenance, and Recoverability (SM&R) Codes.

RELIABILITY—The probability that an item will perform its intended function for a specified interval under stated conditions.

REPAIR—Necessary preparation, fault correction, disassembly, inspection, replacement of parts, adjustment, reassembly, calibration, and/or tests accomplished in restoring items to serviceable status. See Maintenance Types.

REPAIRABLE ITEM—An item of durable nature which, when unserviceable, normally can be economically restored to a serviceable condition through regular repair procedures. (NAVSO P-1500.)

REPAIR CYCLE DATA—Describes an uninterrupted record of a repairable item from the time of removal until repair is completed or a R/S determination is made.

REPAIR PART—Material capable of separate supply and replacement that is required for the maintenance, overhaul, or repair of an end article, (e.g., airframe, accessories, instruments, engine, propeller, electrical, electronics, photographic, armament, training equipment), including repair parts of GSE called for by the contract. This definition does not include GSE end items. See Spares and Spares and Repair Parts.

REPLACEMENT ITEM—An item that is functionally interchangeable with another item, but differs physically from the original in that the installation of the replacement required operations such as drilling, reaming, cutting, filming, shimming, etc.; in addition to the normal application and methods of attachment. (Define Standardization Manual 4120.3-M.)

REPORT—Narrative, tabular, punchcard, or graphic information transmitted from one officer to another.

REPORTING CUSTODIAN—An organizational unit of the lowest echelon of command accepting responsibility (involving accountability to CNO) for aircraft/engines, as designated either by CNO or by the Controlling Custodian of the aircraft/engine. (See OPNAVINST 5442.2 series for specific identification of Reporting Custodians.)

NOTE

Each aircraft/engine at any given instant from Acceptance to Strike is in the reporting custody of one, and only one, Reporting Custodian. See also Controlling Custodian.

REPORTING CUSTODY—See Custody.

REPORTING PERIOD—For the purpose of Maintenance Data System, a reporting period is one month.

REPORTING REQUIREMENT CODE (RRC)—A single-digit, alpha character code which will indicate the type of reporting required on the item to which it applies. The reporting requirement codes are: A—maintenance reporting only; B—maintenance, inventory, and readiness reporting required; C—maintenance, inventory, readiness and utlization reporting required.

RESOURCES—Resources consist of military and civilian personnel, material on hand and on order, the entitlement to procure or use material, utilities, and services required for the performance of a basic mission, including work or services performed for others.

REWORK—See Maintenance Types.

REWORK FACILITY—

a. Primary—That facility designated by NAVAIR as having the primary depot maintenance responsibility for each aircraft, engine, or equipment. In addition to conducting rework, overhaul, or repair of the material listed, the designation as primary rework facility for aircraft and engines carries with it the responsibility for providing engineering and logistics services in accordance with NAVAIR Instruction 4861.1 series. When primary depot maintenance responsibilities are contracted for, engineering and logistics services will be provided for that aircraft or engine by a separately designated rework facility which will also normally be assigned primary manufacturing cognizance.

b. Alternate—That facility, if any, which is assigned maintenance workload for aircraft, engines, or equipment for which another facility has been designated as the primary rework facility. The alternate rework facility will assume supporting engineering responsibilities as a participating field activity in accordance with the definition of NAVAIR Instruction 5400.14 series as requested by and negotiated with the primary rework facility, and will normally have responsibility for secondary manufacturing cognizance and may be separately assigned a rework facility by NAVAIR Instruction 4861.1 series.

SALVAGE—

a. Property that has some value in excess of its basic material content but is in such condition that it has no reasonable prospect of use for any purpose as a unit and its repair or rehabilitation for use as a unit is clearly impracticable. (JCS PUB-1.)

b. The saving or rescuing of condemned, discarded, abandoned property and of materials contained therein for reuse, refabrication, or scrapping. (JCS PUB-1.)

SCALING—Formation of partially adherent oxide layers on a metal surface.

SCHEDULE, MAINTENANCE—See Maintenance Schedule.

SCHEDULING MAINTENANCE—Periodic prescribed inspection and/or servicing of equipment accomplished on a calendar, mileage, or hours of operation basis.

SCREENING—

a. Administrative Screening—The screening of all material received at the intermediate level for repair to determine if the item is within the check/test/repair capability of the IMA.

b. Supply Screening—The screening of material by the Supply Screening Section to determine the disposition of material that cannot be repaired at the intermediate level.

SECOND DEGREE REPAIR—The repair of a damaged or nonoperating gas turbine engine, its accessories or components to an acceptable operating condition. As used in this instruction, repair by designated AIMDs includes the repair/replacement of turbine rotors and combustion sections, including afterburners. Also authorized are the replacement of externally damaged, deteriorated or time-limited components, gear boxes, or accessories and conducting engine calendar (or equivalent) inspections. In addition, minor repair to the compressor section is authorized (e.g., dressing nicks in compressor vanes and blades within limits of the operating and service instructions). Further, the repair or replacement of reduction gear boxes and torque shafts for turboshaft engines and compresor fans of turbofan engines which are considered repairable within the limits of the approved Intermediate Maintenance Manuals shall be done by Second Degree repair activities. (Refer to NAVAIR NOTE 4700 series for specific engine/AIMD assignments.)

SERVICEABLE—A condition of an end item in which all requirements or repair, bench check, overhaul, or modification, as applicable, have been accomplished, making it capable of performing the function or requirements for which originally designed. The fact that signs of previous use are apparent does not necessarily mean that it is unserviceable. When appearance is not a primary consideration, and the condition of the item meets all safety and performance requirements, it will be processed as serviceable.

SERVICE LIFE EXTENSION PROGRAM (SLEP)—SLEP, as one element of CILOP, is the restoration and/or replacement of primary aircraft or equipment structure which has reached its life limit. SLEP is performed for express purpose of establishing an increase service life. The Naval Air Systems Command (NAVAIR) will determine the duration of the service life extension that will be attained by accomplishment of the SLEP.

SERVICING—The replenishment of consumables needed to keep an item in operating condition, but not including any other preventive maintenance. See also Common, Cross, and Joint Servicing and Interservice Support.

SET—See Equipment, Division of.

SHORE ESTABLISHMENT—One of the three principal parts of the Naval Establishment consisting of field activities of the Bureaus and Navy Department and all shore activities not assigned to the operating forces.

SOURCE CODE—See Source, Maintenance, and Recoverability (SM&R) Code.

SOURCE, MAINTENANCE, AND RECOVERABILITY (SM&R) CODE—A collective code assigned to items during the provisioning source coding or selection process to convey specific intelligence to maintenance and supply personnel. The SM&R code consists of three parts—a source code, a maintenance code, and a recoverability code, as follows:

a. Source Codes—Codes assigned to support items (spares, repair parts, components, parts, kits, special tools, test equipment, and ground support equipment) to indicate the manner of acquiring items for the maintenance, repair, or overhaul of end items.

b. Maintenance Codes—Codes assigned to support items to indicate the maintenance levels authorized to remove and replace, repair, overhaul, assemble, inspect and test, and condemn items. Also assigned to maintenance tools and test and ground support equipment end items to indicate the lowest level of maintenance requiring the item.

c. Recoverability Codes—Codes assigned to support items during the provisioning source coding or selection process to indicate to maintenance and supply personnel the reclamation or disposition action required for items that are removed and replaced during maintenance. (See NAVAIRINST 4423.3 series for further explanation.) See Provisioning Source Coding.

SPECIAL UPKEEP—See Maintenance Types.

SPECIFICATION—A document intended primarily for use in procurement, which clearly and accurately describes the essential technical requirements for items, materials, or services, including the procedures by which it will be determined that the requirements have been met.

SQUADRON MANNING DOCUMENT (SQMD)—The SQMD is a document that identifies and justifies manpower requirements in relation to mission, operational assignments and ensure agreement and alignment with present manpower programs, controlling directives, policies, terminology and maintenance/administrative concepts.

STANDARD AERONAUTICAL MATERIAL—Material that is used both within and outside of naval aviation activities.

STANDARD GROUND SUPPORT EQUIPMENT—See Ground Support Equipment.

STANDARD ITEM—A material, part, component, subassembly, or equipment identified or described in military or adopted Federal and industry standards. (Defense Standardization Manual 4120.3 series.)

STANDARDIZATION—The process by which the Department of Defense achieves the closest practical cooperation among the services and Defense Agencies for the most efficient use of research, development, and production resources and agrees to adopt on the broadest possible basis the use of: (1) common or compatible operational administrative and logistic procedures; (2) common or compatible technical procedures and criteria; (3) common, compatible, or interchangeable supplies, components, weapons, or equipment; and (4) common or compatible tactical doctrine with corresponding organizational compatibility. (JCS PUB-1.)

STANDARD NAVY DISTRIBUTION LIST (SNDL)—A list providing official addressing and distribution information for the Naval Establishment. Published in two parts: Part 1 (OPNAV PO9B 207), the Operating Forces of the Navy, and Part 2 (OPNAV PO9B 205). The Catalog of Naval Shore Activities. (SECNAVINST 5215.1 series.)

STANDBY POOL—A grouping of repairable assemblies provided a rework activity as replacement for similar defective repairable assemblies removed from an aircraft or engine undergoing some phase of rework that are not to be reworked concurrently with the aircraft or engine from which removed. These items are provided to prevent disruption of production schedules because the lead time to obtain the required replacement item from supply and the turnaround time of the aircraft/engine are not compatible. (FASOINST 4700.22 series.)

STATUS CODES (MILSTRIP)—Codes that furnish information from supply sources to requisitioners or cosignees of the status of requisition. Supply status (except "rejection" status, Code C) predicts shipment on time as specified by the Priority Delivery Date or the Required Delivery Date. (NAVSUP PUB 437.)

STRESS-CORROSION CRACKING—A type of corrosion which causes cracking and part failure due to a combination of corrosion and sustained tensile stress.

SUBASSEMBLY—See Equipment, Division of.

SUBSTITUTE ITEMS—Two or more items possessing such functional and physical characteristics as to be capable of being exchanged only under certain conditions or in particular applications and without alterations of the items themselves or to adjoining items. (Defense Standardization Manual 4120.3 series.)

SUBSYSTEMS—A combination of two or more equipments, generally physically separated when in operation, and such other components, assemblies, subassemblies, and parts necessary to perform an operational function or functions. See Equipment, Divisions of.

SUPPLIES—All items necessary for the equipment, maintenance, and operation of a military command, including food, clothing, equipment, arms, ammunition, fuel, forage, materials, and machinery.

SUPPLY—All items necessary for the equipment.

SUPPLY—The procurement, distribution, maintenance while in storage, and salvage of supplies, including the determination of kind and quantity of supplies. (JCS PUB-1.)

SUPPLY RESPONSE SECTION (SRS)—The section of the Supply Support Center that receives requests for material and causes the issue and delivery of the requested material to be made.

SUPPLY SCREENING SECTION (SSS)—The section of the Supply Support Center that screens and forwards, for dispositions, all components processed at the intermediate level.

SUPPLY SUPPORT CENTER (SSC)—A function of the supporting supply activity. It is the liaison point for all material requirements. The SSC includes a Component Control Section (CCS), and Supply Response Section (SRS).

SUPPORT—

a. The action of a force that aids, protects, complements, or sustains another force in accordance with a directive requiring such action.

b. A unit that helps another unit in battle. Aviation, artillery, or Naval gunfire may be used as a support for infantry.

c. A part of any unit held back at the beginning of an attack as a reserve.

d. An element of a command that assists, protects, or supplies other forces in combat. See also Interdepartmental/Agency Support and Interservice Support.

SUPPORTING AIRCRAFT—All active aircraft other than unit aircraft. (JCS PUB-1.)

SYSTEM—A composite of subsystems, assemblies (or sub-sets), skills, and techniques capable of performing and/or supporting an operational (or nonoperational) role. A complete system includes related facilities, items, material, services, and personnel that it can be considered a self-sufficient item in its intended operational (or nonoperational) and/or support environment. See Equipment, Division of.

SYSTEM SHOP TEST BENCH (AVIONICS)—Used to determine performance and isolate faults in equipment (avionics). Is considered to consist of a Test Bench Harness (TBH), necessary test equipment(s), power supply, work benches and applicable simulators and handbooks (manuals) for equipment and test equipment.

NOTE

Although frequently handled separately, equipment common to the aircraft configuration supported (for maintenance training activities, those equipments on which training is being conducted) shall be considered, for purposes of allowance and custody, as an integral part of the TBL as listed in the allowance list. Equipments are not authorized for use with a TBH when simulators are provided in lieu thereof.

TABLES OF BASIC ALLOWANCE—See Aeronautical Allowance Lists.

TECHNICAL CHARACTERISTICS—Those characteristics of equipment that pertain primarily to the engineering principles involved in producing equipment possessing desired military characteristics, e.g., for electronic equipment, technical characteristics include such items as circuitry and types and arrangement of components. (JCS PUB-1.)

TECHNICAL DATA—Data required for the accomplishment of logistics and engineering process in support of the contract end item. It includes drawings, operating and maintenance instructions, provisioning information, specifications, inspection and test procedures, instruction cards and equipment placards, engineering and support analysis data, special purpose computer programs, and other forms of audiovisual presentation required to guide personnel in the performance of operating and support tasks.

TECHNICAL DIRECTIVE (TD)—A document, authorized and promulgated by NAVAIR. It provides technical information necessary to properly and systematically inspect or alter the configuration of aircraft, engines, systems, or equipments subsequent to establishment of each respective baseline configuration. These technical directives include all types of changes and bulletins and consist of information that cannot be disseminated satisfactorily by revisions to technical manuals. Naval Air Technical Services Facility (NATSF) controls assignment of Technical Directive numbers.

TECHNICAL MANUAL (TM)—A publication containing a description of equipment, weapons, or weapons systems with instructions for effective use, including one or more of the following sections, as required: instructions covering initial preparation for use; operational instruction; modification instructions; inspection procedures, parts list, or parts breakdown; and related technical information or procedures, exclusive of those of an administrative nature.

TENANT—Any activity that will be aboard a ship or station for a period of time sufficient to require specific assignment of shop, hangar, crew, and equipment or line spaces. Activities may utilize a facility as an assigned tenant or as a joint tenant. Specific spaces may be assigned on a rotational, seasonal, occasional, or transient basis as appropriate. See Joint Tenant.

TEST—Applies to the subjection of an aircraft, airframe, engine, accessory, or item of equipage to prescribed conditions to determine that it will function in accordance with predetermined requirements. See also Bench Test, Functional Test, and Service Test.

TESTING—An element of inspection that generally denotes the determination by technical means of the properties or elements of supplies, or components thereof, including functional operations, and involves the application of established scientific principles and procedures.

THIRD DEGREE REPAIR—Encompasses the same gas turbine engine repair capability as the Second Degree Repair except that certain functions which require high maintenance man-hours and are of low incident rate are excluded. (Refer to NAVAIR NOTE 4700 series for specific engine/AIMD assignments.)

TOTAL ASSETS (MAN-HOUR ASSETS)—Net assigned man-hours plus overtime (less overtime performed in labor codes 810 through 870).

TOXIC—Poisonous, either by ingestion, inhalation, or absorption through the skin.

TRAINING AIDS—Any item developed and/or procured with the primary intent that it shall assist in training and the process of learning. (JCS PUB-1.)

TRANSFER—The act of conveying reporting/controlling custody of an aircraft or equipment to another custodian. (OPNAVINST 5442.2 series.)

TRANSIENT—Personnel, ships, or craft stopping temporarily at a post station or port to which they are not assigned or attached and having destination elsewhere. (JCS PUB-1.)

TYPE COMMANDS—See Administrative Commands.

UNIT—

a. Any military element whose structure is prescribed by competent authority, such as a table of organization and equipment; specifically, part of an organization.

b. An organizational title of a subdivision of a group in a task force.

c. A standard of basic quantity into which an item of supply is divided, issued, or used in this meaning, also called unit of issue. See Maintenance Activity and Equipment, Division of.

UNIT OF ISSUE—In its special storage meaning, refers to the quantity of an item, as each number, dozen, gallon, pair, pound, ream, set, yard. Usually termed "unit of issue" to distinguish from "unit price." (JCS PUB-1.)

UNSCHEDULED MAINTENANCE—Maintenance other than the fix phase of scheduled maintenance occurring during the interval between scheduled downtime maintenance periods.

UPKEEP—See Maintenance Types.

UPTIME—That portion of active time during which an item is alert, reacting, or performing a mission.

VENDOR—A manufacturer or supplier of a commerical item.

VENDOR ITEM—Vendor item or vendor parts are all items that are used in or attached to the article produced by the contractor under the contract and that are procured by the contractor in the open market or from established sources and for which the contractor does not have proprietary rights.

VERSATILE AVIONICS SHOP TEST (VAST)—An automatic, high-speed, computer controlled, general purpose test system that will isolate faults to a piece/part level.

VISUAL INFORMATION DISPLAY SYSTEM/MAINTENANCE ACTION FORM (VIDS/MAF)—A multi-purpose document used

301

in the Maintenance Data Reporting and Visual Information Display Systems.

WARNINGS, CAUTIONS, AND NOTES—The following are definitions of the WARNINGS, CAUTIONS, and NOTES found in this manual.

WARNING

An operating procedure, practice or condition, etc., which can result in personal injury or death if not carefully observed or followed.

CAUTION

An operating procedure, practice or condition, etc ., which can damage the equipment if not carefully observed or followed.

NOTE

An operating procedure, practice, or condition, etc., which is essential to emphasize.

WHEN DISCOVERED CODE—See Data Collection Codes, 3-M.

WORK CENTER—A designated functional area to which maintenance personnel are assigned.

WORK CENTER SUPERVISOR—That person assigned the responsibility of maintenance management within a given work center.

WORK UNIT CODE (WUC)—See Data Collection Codes, 3-M.

INDEX

A

Accountable item, AMMRL, 4-4
Acronyms, AI-1 to AI-9
Adjustable wrenches, 7-7
ADMRL, Application Data for Material Readiness List, 4-4
AIMD, Administrative Screening Unit, 4-19
Air conditioners, GSE, 6-17 to 6-18
  NR-5C, 6-18
  NR-10, 6-18
Aircraft Application List, NAVAIR 00-500B, 3-4 to 3-5
Aircraft firefighting and rescue equipment, 6-23 to 6-27
  A/S 32 P-16 firefighting truck, 6-25 to 6-27
  MB-5, 6-23 to 6-25
  SB/TAU-2 firefighting unit, 6-25
Aircraft jacks, 6-51
Aircraft spotting dolly, SD-10, 6-8 to 6-9
Aircraft tow bars, 6-52 to 6-54
Airfield maintenance truck, P-36, 6-23
Airframes division, NAMP, 2-9
Alternate item, AMMRL, 4-4
Aluminum, corroded parts, 9-4
AMMRL, Aircraft Maintenance Material Readiness List Program, 4-3 to 4-4
  accountable item, 4-4
  alternate item, 4-4
  Application Data for Material Readiness List (ADMRL), 4-4
  excess "in-use" accountable GSE, 4-4
  ground support equipment (GSE), 4-4
  Individual Material Readiness List (IMRL), 4-4
Appropriations, Navy supply, 4-2
Armament equipment division, NAMP, 2-11
AS tools, 7-1 to 7-2
  ASE handtools, 7-1
  common handtools, 7-1
  special tools, 7-1 to 7-2
Aviation publications, miscellaneous, 3-13 to 3-17
Aviation supply system, 4-1 to 4-21
  material identification, 4-9 to 4-21
    material identification aids, 4-12
    material turn-in, 4-18 to 4-20
    National Stock Numbers (NSN), 4-9
    naval material catalog, 4-13 to 4-17
    parts kit codes, 4-18
    preexpended bins, 4-18
    standardization of item nomenclature, 4-12
    supply discipline, 4-20 to 4-21
  organization and function of Navy supply, 4-1 to 4-9
    Aircraft Maintenance Material Readiness List (AMMRL) Program, 4-3 to 4-4
    appropriations, 4-2
    Component Control Section (CCS), 4-6 to 4-9
    material allowance documents, 4-4
    material control functions, 4-5 to 4-6
    operating budgets, 4-3
    operating targets, 4-3
    responsibilities of the Navy Supply Systems Command, 4-2
    supply department organization, 4-5
    Supply Support Center, 4-6
  summary, 4-21
Aviation Support Equipment Technician (AS) rating, 1-2 to 1-3
Aviation equipment division, NAMP, 2-11
Avionics division, NAMP, 2-11
Avionics GSE, 6-1

B

- Backup rings, hardware, 8-6 to 8-11
  - identification, 8-7
  - installation, 8-7 to 8-8
- Ball-peen hammers, 7-25
- Bolts, hardware, 8-13 to 8-15
  - bolt material, 8-15
  - bolt threads, 8-14
  - boltheads, 8-14
  - safety wire, 8-15
- Bucking bars, striking tools, 7-27
- Budgets, operating, Navy supply, 4-3

C

- Cadmium and zinc, corroded parts, 9-5
- CCS, Component Control, 4-6 to 4-9
  - document control unit, 4-6
  - Local Repair Cycle Assets (LRCA) Storage Unit, 4-7
  - Supply Response Section (SRS), 4-7
  - Uniform Material Movement and Issue Priority System (UMMIPS), 4-8 to 4-9
- Channel-lock pliers, 7-9
- Chocks, mechanical support equipment, 6-54
- Clamps, hardware, 8-20 to 8-21
- Coating systems, corrosion, GSE, 9-18 to 9-19
  - chemical conversion coating, 9-18
    - for aluminum, 9-18
    - for steel, 9-18
  - finish coatings, 9-19
  - primers, 9-18 to 9-19
    - barrier, 9-18
    - corrosion-inhibitor, 9-18 to 9-19
    - sacrificial, 9-18
- Combination wrenches, 7-6
- Communication and function, rating structure, 1-1
- Compression tester, 7-37
- Concentration cell corrosion, 9-9 to 9-10
- Contamination, petroleum products, 8-31
- Copper and copper alloys, corroded parts, 9-5
- Corroded parts, appearance of, GSE, 9-4 to 9-5
  - aluminum, 9-4
  - cadmium and zinc, 9-5
  - copper and copper alloys, 9-5
  - iron and steel, 9-4
  - magnesium, 9-4
  - nickel and chromium alloys, 9-5
- Corroded surfaces, repair of, 9-14 to 9-18
  - corrosion removal and surface preparation, 9-14 to 9-18
    - chemical cleaning methods, 9-17 to 9-18
    - cleaning surfaces with power tools, 9-16
    - hand cleaning, 9-17
    - mechanical corrosion removal, 9-15
    - removing dirt, oil, and grease, 9-15
- Corrosion, causes of, GSE, 9-1 to 9-4
- Corrosion, forms of, GSE, 9-5 to 9-12
  - concentration cell corrosion, 9-9 to 9-10
  - direct surface attack, 9-6
  - exfoliation, 9-7
  - fatigue corrosion, 9-11
  - fretting corrosion, 9-12
  - galvanic or dissimilar metals, corrosion, 9-7 to 9-9
  - intergranular attack, 9-11
  - microbiological corrosion, 9-7
  - pitting,9-10
  - stress corrosion control, 9-11
  - uniform etch corrosion, 9-7
- Corrosion in electrical equipment, 9-12 to 9-13
  - electrical circuits, 9-13
- Corrosion prevention, 9-13 to 9-14
  - cleaning, 9-14
  - inspection, 9-14
  - lubrication, 9-14
  - preservation, 9-14
  - preventive maintenance schedule, 9-14
- Cotter pins, hardware, 8-16
- Crimping tools, 7-14
- Custody of tools, 7-2
- Cutting tools, 7-3 to 7-4
  - diagonal pliers, 7-3
  - files, 7-4
  - hacksaws, 7-4
- Cylinder leakage test, 7-37

D

- Definition of terms, AII-1 to AII-37
- Depot maintenance, 2-4 to 2-5
- Descriptive/Identification Lists and Illustrated Shipboard Shopping Guides, 4-14
- Diagonal pliers, 7-3
- Diesel, fuels, 8-25
- Direct surface attack corrosion, 9-6

Directive Application List, NAVAIR 00-500C (Series), 3-5
Divisions, NAMP, 2-5 to 2-16
  equipment records, 2-13 to 2-16
  maintenance, 2-11 to 2-13
  production, 2-9 to 2-11
  staff, 2-5 to 2-9
Document control unit, 4-6
Dollies, unpowered, 6-34
DSNL, Navy Deleted and Superseded NIIN List, 4-14
Duckbill pliers, 7-10
Dynamometers, 7-40

E

Eligibility for GSE training, 5-6
Engine testing equipment, 7-36 to 7-40
  compression tester, 7-37
  cylinder leakage tester, 7-37
  dynamometers, 7-40
  exhaust gas analyzer, 7-39
  ignition stroboscope (timing light), 7-40
  tachometer, 7-36
  vacuum gage, 7-38
Enlisted rating structure, 1-2
Equipment Applicability List, NAVAIR 00-500A, 3-2 to 3-4
  column headings, 3-2 to 3-4
Equipment licenses for which requirements are not specified, 5-7
Equipment records, NAMP, 2-13 to 2-16
  GSE Custody and Maintenance Record, 2-13, 2-14
  GSE Daily Record, 2-13, 2-16
  GSE Sub-Custody and Periodic Maintenance Record, 2-13, 2-15
ERLs/SELs, Support Equipment Reference Lists, 4-14
Excess "in-use" accountable GSE, AMMRL, 4-4
Exfoliation, corrosion, 9-7
Exhaust gas analyzer, 7-39

F

Fasteners, hardware, 8-19 to 8-20
  threaded, 8-19
  turnlock, 8-18 to 8-20
Fatigue corrosion, 9-11
Files, cutting tools, 7-4
Finish coatings, coating systems, corrosion, 9-19
Flashlight, tools, 7-11
Flat surface, measuring, micrometers, 7-24
FLEDS, flight line electrical distribution system, 6-16
Forklift truck, 6-16
Fretting corrosion, 9-12
Fuels, 8-21 to 8-26
  diesel, 8-25
  gasoline, 8-21 to 8-25
  JP-5, 8-26
  safe handling of fuels, 8-26

G

Galvanic or dissimilar metals corrosion, 9-7 to 9-9
Gas turbine power servicing equipment, 6-18, 6-20 to 6-22
  GTC-85, 6-20
  NCPP-105, 6-20 to 6-22
Gaskets, hardware, 8-12
Gasoline, fuels, 8-21 to 8-25
Greases, lubricants, 8-28
Ground support equipment, 6-1 to 6-57
  aircraft firefighting and rescue equipment, 6-23 to 6-27
    A/S 32P-16 firefighting truck, 6-25 to 6-27
    MB-5, 6-23 to 6-25
    SB/TAU-2 firefighting unit, 6-25
  aircraft spotting dolly, SD-10, 6-8 to 6-9
  flight line electrical distribution system, 6-16
  forklift truck, 6-16
  gas turbine power servicing equipment, 6-18, 6-20 to 6-22
    GTC-85, 6-20
    NCPP-105, 6-20 to 6-22
  general safety ground support equipment, 6-57
  honing machine, 6-32 to 6-34
  hydraulic fluid servicing equipment, 6-28 to 6-31
    model 310, 6-31
    model H-250-1, 6-29 to 6-31
    model HSU-1, 6-31
  hydraulic test stands, 6-27 to 6-28

- Ground support equipment—Continued
  - liquid oxygen servicing trailer (type NO 4), 6-39 to 6-51
    - gaseous oxygen servicing trailers, 6-49 to 6-51
    - TMU 70/M, low loss, closed loop, liquid oxygen servicing trailer, 6-44 to 6-49
  - mechanical support equipment, 6-51 to 6-56
    - aircraft jacks, 6-51
    - aircraft tow bars, 6-52 to 6-54
    - chocks, 6-54
    - tiedowns, 6-54 to 6-56
    - workstands, 6-52
  - mobile cranes, 6-9 to 6-12
    - MB-1A, 6-11 to 6-12
    - NS-60, 6-9
  - mobile electrical power plants, 6-12 to 6-15
    - NC-2A, 6-12
    - NC-8A, 6-13
    - NC-10B, 6-14 to 6-15
  - mobile motor-generator sets, 6-15
    - MMG-2, 6-15
  - nitrogen servicing unit, 6-36 to 6-38
    - nitrogen, 6-37 to 6-38
  - oxygen servicing units, 6-38 to 6-39
    - oxygen, 6-38 to 6-39
  - P-36 airfield maintenance truck, 6-23
  - preheaters and air conditions, 6-17 to 6-18
  - preservation/depreservation trailer, 6-35 to 6-36
  - steam cleaners, 6-31 to 6-32
  - tow tractor and aircraft spotting dollies, 6-2 to 6-8
    - AS 32A-30 aircraft ground support equipment tractor, 6-4
    - MD-3 tow tractor, 6-5
    - MRS-190 tow tractor, 6-4
    - operations of tow tractor, 6-5 to 6-8
    - TA-18 tow tractor, 6-3
    - TA-75 A/B tow tractor, 6-4
  - trailers, dollies, and carts, 6-34 to 6-35
    - carts, 6-35
    - unpowered dollies, 6-34
  - types, 6-1 to 6-2
    - avionics,6-1
    - non-avionics, 6-2
  - weapons loader, 6-22
- Ground Support Equipment Cleaning and Corrosion Control, NAVAIR 17-1-125, 9-20
- Ground support equipment corrosion control, 9-1 to 9-20
  - appearance of corroded parts, 9-4 to 9-5
    - aluminum, 9-4
    - cadmium and zinc, 9-5
    - copper and copper alloys, 9-5
    - iron and steel, 9-4
    - magnesium, 9-4
    - nickel and chromium alloys, 9-5
  - causes of corrosion, 9-1 to 9-4
  - coating systems, 9-18 to 9-19
    - chemical conversion coating, 9-18
    - finish coatings, 9-19
    - primers, 9-18 to 9-19
  - corrosion in electrical equipment, 9-12 to 9-13
    - electrical circuits, 9-13
  - corrosion prevention, 9-13 to 9-14
    - cleaning, 9-14
    - inspection, 9-14
    - lubrication, 9-14
    - preservation, 9-14
    - preventive maintenance schedule, 9-14
  - forms of corrosion, 9-5 to 9-12
    - concentration cell corrosion, 9-9 to 9-10
    - direct surface attack, 9-6
    - exfoliation, 9-7
    - fatigue corrosion, 9-11
    - fretting corrosion, 9-12
    - galvanic or dissimilar metals corrosion, 9-7 to 9-9
    - integranular attack, 9-11
    - microbiological corrosion,9-7
    - pitting, 9-10
    - stress corrosion control, 9-11
    - uniform etch corrosion, 9-7
  - Ground Support Equipment Cleaning and Corrosion Control, NAVAIR 17-1-125, 9-20
  - repair of corroded surfaces, 9-14 to 9-18
    - corrosion removal and surface preparation, 9-14 to 9-18
- Ground support equipment division, NAMP, 2-11
- GSE general publications, 3-17 to 3-20
- GSE, ground support equipment, AMMRL, 4-4

- GSE training, 5-1 to 5-8
  - GSE operator training program, 5-5 to 5-7
    - eligibility for GSE training, 5-6
    - equipment licenses for which requirements are not specified, 5-7
    - GSE operators licenses, 5-6
    - GSE training material, 5-5
    - licensing procedures for GSE, 5-5
    - revocation of licenses, 5-7
  - organizing a training program, 5-1 to 5-2
  - required reading, 5-7 to 5-8
  - training folder, 5-7
  - training forms and concepts, 5-2 to 5-5
    - formal training, 5-2
    - informal training, 5-3
    - maintenance training, 5-3 to 5-5

H

- Hacksaws, 7-4

- Hammers, striking tools, 7-25 to 7-26
  - ball-peen, 7-25
  - mallet, 7-25
  - planishing, 7-26

- Hardware, fuels, lubricants, and hydraulic fluids, 8-1 to 8-31
  - fuels, 8-21 to 8-26
    - diesel, 8-25
    - gasoline, 8-21 to 8-25
    - JP-5, 8-26
    - safe handling of fuels, 8-26
  - handling petroleum products, 8-29 to 8-31
    - contamination, 8-31
    - safety, 8-29
    - storage, 8-30 to 8-31
  - hardware, 8-1 to 8-15
    - backup rings, 8-6 to 8-11
    - bolts, 8-13 to 8-15
    - gaskets, 8-12
    - O-rings, 8-1 to 8-6
    - seals, 8-1
    - wipers, 8-8, 8-11 to 8-12
  - hydraulic fluids, 8-28 to 8-29
  - lubricants, 8-26 to 8-28
    - greases, 8-28
    - oils, 8-26 to 8-28

- Hardware, fuels, lubricants, and hydraulic fluids—Continued
  - miscellaneous hardware, 8-16 to 8-21
    - clamps, 8-20 to 8-21
    - cotter pins, 8-16
    - rivets, 8-16 to 8-19
    - threaded fasteners, 8-19
    - turnlock fasteners, 8-19 to 8-20
  - summary, 8-31
- Holding tools, 7-9 to 7-10
  - channel-lock pliers, 7-9
  - duckbill pliers, 7-10
  - needlenose pliers, 7-10
  - vise grip pliers, 7-9
- Hole finder, striking tools, 7-27
- Honing machine, 6-32 to 6-34
- Hydraulic fluid servicing equipment, 6-28 to 6-31
  - model 310, 6-31
  - model H-250-1, 6-29 to 6-31
  - model HSU-1, 6-31
- Hydraulic fluids, 8-28 to 8-29
- Hydraulic test stand, 6-27 to 6-28

I

- Ignition stroboscope (timing light), 7-40
- IMRL, Individual Material Readiness List, 4-4
- Injector nozzle tester, 7-44 to 7-45
- Inspection mirror, tools, 7-11
- Insulated tools, 7-12
- Intergranular attack, corrosion, 9-11
- Intermediate maintenance, 2-4
- IPB, Illustrated Parts Breakdown, 4-13
- Iron and steels, corroded parts, 9-4

J

- JP-5, fuels, 8-26

L

- Letter-type directives, 3-21 to 3-24
- Licensing procedures for GSE, 5-5

- Liquid oxygen servicing trailer (type NO 4), 6-39 to 6-51
  - gaseous oxygen servicing trailers, 6-49 to 6-51
    - components, 6-49
    - operating, 6-51
  - operations, NO 4, 6-41 to 6-44
  - TMU 70/M, low loss, closed loop, liquid oxygen servicing trailer, 6-44 to 6-49
    - controls and indicators, 6-45
    - operation, 6-46 to 6-49
    - storage tank, 6-44
    - transfer lines and piping system, 6-45
    - transfer tank, 6-45
- LRCA, Local Repair Cycle Assets Storage Unit, 4-7
- Lubricants, 8-26 to 8-28
  - greases, 8-28
  - oils, 8-26 to 8-28

M

- Magnesium, corroded parts, 9-4
- Maintenance code, Naval material catalogs, 4-17
- Maintenance data reporting, 2-16 to 2-29
  - Support Action Form (SAF), 2-26 to 2-29
    - documentation, 2-27 to 2-29
  - VIDS/MAF, 2-23 to 2-26
- Maintenance levels, 2-4 to 2-5
  - depot, 2-4 to 2-5
  - intermediate, 2-4
  - organizational, 2-4
- Maintenance/material control division, 2-8 to 2-9
- Maintenance, NAMP, 2-11 to 2-13
  - scheduled, 2-11
  - unscheduled, 2-13
- Mallet, hammers, 7-25
- Material allowance documents, Navy supply, 4-4
- Material control functions, 4-5 to 4-6
  - intermediate level, 4-5
  - organizational level, 4-6
- Material identification, 4-9 to 4-21
  - material identification aids, 4-12
  - material turn-in, 4-18 to 4-20
  - National Stock Numbers, 4-9
  - naval material catalogs, 4-13 to 4-17
  - parts kit codes, 4-18
  - preexpended bins, 4-18
  - standardization of item nomenclature, 4-12
  - supply discipline, 4-20 to 4-21
- Material turn-in, 4-18 to 4-20
  - Administrative Screening Unit (AIMD), 4-19
  - servmart support, 4-20
- Measuring hole diameters with an inside micrometer caliper, 7-23
- Mechanical fingers, tools, 7-10
- Mechanical support equipment, 6-51 to 6-56
  - aircraft jacks, 6-51
  - aircraft tow bars, 6-52 to 6-54
  - chocks, 6-54
  - tiedowns, 6-54 to 6-56
  - workstands, 6-52
- MEPP, mobile electrical power plants, 6-12 to 6-15
  - NC-2A, 6-12
  - NC-8A, 6-13 to 6-14
    - power supply/transformer rectifier (T/R Unit), 6-13 to 6-14
  - NC-10B, 6-14 to 6-15
- MIARS, Maintenance Information Automatic Retrieval System, 3-25 to 3-26
- Microbiological corrosion, 9-7
- Microfilm Cartridge Cross Reference, NAVAIR 00-500M (Series), 3-5
- Micrometer caliper, reading, 7-20 to 7-22
- Micrometers, 7-19 to 7-25
  - care of micrometers, 7-24 to 7-25
  - measuring a flat surface, 7-24
  - measuring hole diameters with an inside micrometer caliper, 7-23
  - measuring round stock, 7-23
  - reading a micrometer caliper, 7-20 to 7-22
  - reading a vernier micrometer caliper, 7-22
  - selecting the proper micrometer, 7-19
  - types, 7-19
- MMGS, mobile motor-generator sets, 6-15
  - MMG-2, 6-15
- Mobile cranes, 6-9 to 6-12
  - MB-1A, 6-11 to 6-12
  - NS-60, 6-9

N

- NAMP, Naval Aviation Maintenance Program, 2-1 to 2-29
  - background, 2-1 to 2-3
  - divisions, 2-5 to 2-16
    - equipment records, 2-13 to 2-16
    - maintenance, 2-11 to 2-13
    - production, 2-9 to 2-11
    - staff, 2-5 to 2-9

- NAMP, Naval Aviation Maintenance Program—Continued
  - maintenance data reporting, 2-16 to 2-29
    - Support Action Form (SAF), 2-26 to 2-29
    - VIDS/MAF, 2-23 to 2-26
  - purpose of NAMP organization, 2-3 to 2-5
    - maintenance levels, 2-4 to 2-5
    - OPNAVINST 4790.2 series, 2-3
    - organizational structure, 2-5
- Naval Aeronautic Publication Index, 3-1 to 3-10
- Naval Aeronautic publications, 3-10 to 3-24
- Naval material catalogs, 4-13 to 4-17
  - Descriptive/Identification Lists and Illustrated Shipboard Shopping Guides, 4-14
  - Illustrated Parts Breakdown (IPB), 4-13
  - maintenance code, 4-17
  - Navy Deleted and Superseded NIIN List (DSNL), 4-14
  - Navy Management Data List, 4-14
  - recoverability codes, 4-17
  - source codes, 4-14 to 4-17
  - Support Equipment Reference Lists (ERLs/SELs), 4-14
- Navy Stock List of Publications and Forms, NAVSUP 2002, 3-7 to 3-10
- Needlenose pliers, 7-10
- Nickel and chromium alloys, corroded parts, 9-5
- Nitrogen servicing unit, 6-36 to 6-38
  - nitrogen, 6-37 to 6-38
- NMDL, Navy Management Data List, 4-14
- Non-Avionics GSE, 6-2
- Nonmagnetic tools, 7-12
- NSN, National Stock Numbers, 4-9 to 4-11
  - material condition codes, 4-10
  - material control codes, 4-10
  - types of stock numbers, 4-9
- Numbering system, publications, 3-10 to 3-12
  - letter-type directive, 3-12
  - manuals, 3-11

O

- Occupational standards, rating structure, 1-1
- Oils, lubricants, 8-26 to 8-28
  - turbine oil, 8-28
  - types and designations, 8-27
- OPNAVINST 4790.2 series, NAMP, 2-3
- Organizational maintenance, 2-4
- Organizational structure, NAMP, 2-5
- O-rings, hardware, 8-1 to 8-6
  - identification, 8-1
  - removal and installation, 8-3 to 8-6
  - storage, 8-2
- Oxygen servicing units, 6-38 to 6-39
  - oxygen, 6-38 to 6-39

P

- Parts kit codes, material identification, 4-18
  - C kit—cure data component kits, 4-18
  - D kit—overhaul kit, 4-18
  - F kit—fleet kit, 4-18
- Petroleum products, handling, 8-29 to 8-31
  - contamination, 8-31
  - safety, 8-29
  - storage, 8-30 to 8-31
- Pitting, corrosion, 9-10
- Planishing hammer, 7-26
- Pliers, holding tools, 7-9 to 7-10
  - channel-lock, 7-9
  - duckbill, 7-10
  - needlenose, 7-10
  - vise grip, 7-9
- Pneumatic riveters, striking tools, 7-27 to 7-30
  - corner riveter, 7-29
  - fast-hitting gun, 7-29
  - one-shot gun, 7-28
  - riveter gun selection, 7-29 to 7-30
  - slow-hitting gun, 7-29
  - squeeze riveter, 7-29
- Powerplants division, NAMP, 2-11
- Preexpended bins, material identification, 4-18
- Preheaters, 6-17
- Preservation/depreservation trailer, 6-35 to 6-36
- Preventive maintenance schedule, corrosion, 9-14
- Primers, coating systems, corrosion, 9-18 to 9-19
- Procurement of publications, 3-13
- Production divisions, NAMP, 2-9 to 2-11
  - airframes, 2-9
  - armament equipment, 2-11
  - aviators equipment, 2-11
  - avionics, 2-11
  - ground support equipment, 2-11
  - powerplants, 2-9
- Publications, 3-1 to 3-26
  - MIARS, Maintenance Information Automatic Retrieval System, 3-25 to 3-26

Publications—Continued
  Naval Aeronautic Publication Index, 3-1 to 3-10
    Aircraft Application List, NAVAIR 00-500B, 3-4 to 3-5
    Directive Application List, NAVAIR 00-500C (Series), 3-5
    Equipment Applicability List, NAVAIR 00-500A, 3-2
    Microfilm Cartridge Cross Reference, NAVAIR 00-500M (Series), 3-5
    Navy Stock List of Publications and Forms, NAVSUP 2002, 3-7 to 3-10
    Support Equipment Cross Reference, NAVAIR 00-500SE, 3-6
  naval aeronautic publications, 3-10 to 3-24
    GSE general publications, 3-17 to 3-20
    letter-type directives, 3-21 to 3-24
    miscellaneous aviation publications, 3-13 to 3-17
    procurement of publications, 3-13
    publications numbering system, 3-10 to 3-12
    security of classified publications, 3-12
    updating manuals, 3-20 to 3-21
  Technical Publications Library, 3-24 to 3-25
    filing and storage, 3-24 to 3-25
Pullers, striking tools, 7-30 to 7-35
  care, 7-35
  types, 7-30 to 7-33
  use, 7-33 to 7-35

Q

Quality assurance/analysis division, 2-6 to 2-8

R

Rating structure, 1-1 to 1-4
  Aviation Support Equipment Technician (AS) rating, 1-2 to 1-3
  communication and function, 1-1
  enlisted rating structure, 1-2
  occupational standards, 1-1
  sources of information, 1-3 to 1-4
Recoverability codes, naval material catalogs, 4-17
Relay tools, 7-12
Revocation of licenses, GSE, 5-7
Rivet head shaver, striking tools, 7-27
Rivets, hardware, 8-16 to 8-19
    identification code, 8-17 to 8-19
Round stock measuring, micrometers, 7-23

S

SAF, Support Action Form, 2-26 to 2-29
Safe handling of fuels, 8-26
Safety, general, GSE, 6-57
Safety, petroleum products, 8-29
Safety wire, bolts, hardware, 8-15
Screwdrivers, 7-7 to 7-9
    common, 7-7 to 7-9
    crosspoint, 7-9
    offset, 7-9
Seals, hardware, 8-1
Security of classified publications, 3-12
Selecting the proper micrometer, 7-19
Socket wrenches, 7-4 to 7-6
    accessories, 7-5 to 7-6
    hinged handle, 7-5
    ratchet handle, 7-4
    sliding T-bar handle, 7-5
    sockets, 7-4
    speed handle, 7-5
Source codes, naval material catalogs, 4-14 to 4-17
Sources of information, rating structure, 1-3 to 1-4
Spark plug cleaner and tester, 7-45
Specifications, tools and their equipment, 7-35
SRS, Supply Response Section, 4-7
Staff division, NAMP, 2-5 to 2-9
    administrative, 2-5
    maintenance/material control, 2-8 to 2-9
    quality assurance/analysis, 2-6 to 2-8
Steam cleaners, 6-31 to 6-32
Steel scale, tools, 7-10
Storage, petroleum products, 8-30 to 8-31
Stress corrosion control, 9-11
Striking tools, 7-25 to 7-35
    bucking bars, 7-26
    hammers, 7-25 to 7-26
        ball-peen, 7-25
        mallets, 7-25
        planishing, 7-26
    hole finder, 7-27

310

U.S. GOVERNMENT PRINTING OFFICE: 1981-546-093/50

- Striking tools—Continued
  - pneumatic riveters, 7-27 to 7-30
    - corner riveter, 7-29
    - fast-hitting gun, 7-29
    - one-shot gun,7-28
    - riveter gun selection, 7-29 to 7-30
    - slow-hitting gun, 7-29
    - squeeze riveter, 7-29
  - pullers, 7-30 to 7-35
    - care, 7-35
    - types, 7-30 to 7-33
    - use, 7-33 to 7-35
  - rivet head shaver, 7-27
- Supply department organization, 4-5
- Supply discipline, material identification, 4-20 to 4-21
- Supply Support Center, 4-6
- Support Equipment Cross Reference, NAVAIR 00-500SE, 3-6

T

- Tachometer, 7-36
- Targets, operating, Navy supply, 4-3
- Technical Publications Library, 3-24 to 3-25
  - filing and storage, 3-24 to 3-25
- Threaded fasteners, 8-19
- Tiedowns, mechanical support equipment, 6-54 to 6-56
- Timing light (ignition stroboscope), 7-40
- Toolboxes, 7-2 to 7-3
- Tools and their equipment, 7-1 to 7-46
  - AS tools, 7-1 to 7-2
    - ASE handtools, 7-1
    - common handtools, 7-1
    - special tools, 7-1 to 7-2
  - custody of tools, 7-2
  - cutting tools, 7-3 to 7-4
    - diagonal pliers, 7-3
    - files, 7-4
    - hacksaws, 7-4
  - engine testing equipment, 7-36 to 7-40
    - compression tester, 7-37
    - cylinder leakage tester, 7-37
    - dynamometers, 7-40
    - exhaust gas analyzer, 7-39
    - ignition stroboscope (timing light), 7-40
    - tachometer, 7-36
    - vacuum gage, 7-38
- Tools and their equipment—Continued
  - holding tools, 7-9 to 7-10
    - channel-lock pliers, 7-9
    - duckbill pliers, 7-10
    - needlenose pliers, 7-10
    - vise grip pliers, 7-9
  - injector nozzle tester, 7-44 to 7-45
  - micrometers, 7-19 to 7-25
    - care of micrometers, 7-24 to 7-25
    - measuring a flat surface, 7-24
    - measuring hole diameters with an inside micrometer caliper, 7-23
    - measuring round stock, 7-23
    - reading a micrometer caliper, 7-20 to 7-22
    - reading a vernier micrometer caliper, 7-22
    - selecting the proper micrometer, 7-19
    - types, 7-19
  - miscellaneous tools, 7-10 to 7-19
    - crimping tools, 7-14
    - flashlight, 7-11
    - inspection mirror, 7-11
    - insulated tools, 7-12
    - mechanical fingers, 7-10
    - nonmagnetic tools, 7-12
    - relay tools, 7-12
    - steel scale, 7-10
    - torque controlled power tools, 7-18 to 7-19
    - torque screwdrivers, 7-18
    - torque wrenches, 7-14 to 7-18
    - wire and cable strippers, 7-13
  - spark plug cleaner and tester, 7-45
  - specifications, 7-35
  - striking tools, 7-25 to 7-35
    - bucking bars, 7-26
    - hammers, 7-25 to 7-26
    - hole finder, 7-27
    - pneumatic riveters, 7-27 to 7-30
    - pullers, 7-30 to 7-35
    - rivet head shaver, 7-27
  - summary, 7-45 to 7-46
  - toolboxes, 7-2 to 7-3
  - turning tools, 7-4 to 7-9
    - adjustable wrenches, 7-7
    - combination wrenches, 7-6
    - screwdrivers, 7-7 to 7-9
    - socket wrenches, 7-4 to 7-6

- Tools and their equipment—Continued
  - valve repair equipment, 7-40 to 7-44
    - lapper, 7-42
    - refacer, 7-41
    - seat grinder, 7-41
    - spring compressor, 7-44
    - spring tester, 7-43
- Torque controlled power tools, 7-18 to 7-19
- Torque screwdrivers, 7-18
- Torque wrenches, 7-14 to 7-18
- Tow tractor, 6-2 to 6-8
  - AS 32A-30 aircraft GSE tractor, 6-4
  - MD-3, 6-5
  - MRS-190, 6-4
  - operations of, 6-5 to 6-8
  - TA-18, 6-3
  - TA-75A/B, 6-4
- Trailers, dollies, and carts, 6-34 to 6-35
  - carts, 6-35
  - unpowered dollies, 6-34
- Training folder, GSE, 5-7 to 5-8
- Training forms and concepts, 5-2 to 5-5
  - formal training, 5-2
  - informal training, 5-3
    - knowledge development, 5-3
    - professional training, 5-3
  - maintenance training, 5-3 to 5-5
- Turbine oil, lubricants, 8-28
- Turning tools, 7-4 to 7-9
  - adjustable wrenches, 7-7
  - combination wrenches, 7-6
  - screwdrivers, 7-7 to 7-9
  - socket wrenches, 7-4 to 7-6
- Turnlock fasteners, 8-19 to 8-20
- Types of micrometers, 7-19

U

- UMMIPS, Uniform Material Movement and Issue Priority System, 4-8 to 4-9
- Uniform etch corrosion,9-7
- Updating manuals, 3-20 to 3-21

V

- Vacuum gage, 7-38
- Valve repair equipment, 7-40 to 7-44
  - lapper, 7-42
  - refacer, 7-41
  - seat grinder, 7-41
  - spring compressor, 7-44
  - spring tester, 7-43
- Vernier micrometer caliper, reading a, 7-22
- VIDS/MAF, 2-23 to 2-26
- Vise grip pliers, 7-9

W

- Weapons loader, 6-22
- Wipers, hardware, 8-8, 8-11 to 8-12
- Wire and cable strippers, 7-13
- Workstands, 6-52
- Wrenches, 7-4 to 7-7, 7-14 to 7-18
  - adjustable, 7-7
  - combination, 7-6
  - socket, 7-4 to 7-6
  - torque, 7-14 to 7-18

AVIATION SUPPORT EQUIPMENT TECHNICIAN (ASE 3&2 AND ASM 3&2) VOLUME 1, BASICS

NAVEDTRA 10325

Prepared by the Naval Education and Training Program Development Center, Pensacola, Florida

---

Your NRCC contains a set of assignments and perforated answer sheets. The Rate Training Manual, Aviation Support Equipment Technician (ASE 3 & 2 and ASM 3 & 2) Volume 1, Basics, NAVEDTRA 10325, is your textbook for the NRCC. If an errata sheet comes with the NRCC, make all indicated changes or corrections. Do not change or correct the textbook or assignments in any other way.

HOW TO COMPLETE THIS COURSE SUCCESSFULLY

Study the textbook pages given at the beginning of each assignment before trying to answer the items. Pay attention to tables and illustrations as they contain a lot of information. Making your own drawings can help you understand the subject matter. Also, read the learning objectives that precede the sets of items. The learning objectives and items are based on the subject matter or study material in the textbook. The objectives tell you what you should be able to do by studying assigned textual material and answering the items.

At this point you should be ready to answer the items in the assignment. Read each item carefully. Select the BEST ANSWER for each item, consulting your textbook when necessary. Be sure to select the BEST ANSWER from the subject matter in the textbook. You may discuss difficult points in the course with others. However, the answer you select must be your own. Remove a perforated answer sheet from the back of this text, write in the proper assignment number, and enter your answer for each item.

Your NRCC will be administered by your command or, in the case of small commands, by the Naval Education and Training Program Development Center. No matter who administers your course you can complete it successfully by earning a 3.2 for each assignment. The unit breakdown of the course, if any, is shown later under Naval Reserve Retirement Credit.

WHEN YOUR COURSE IS ADMINISTERED BY LOCAL COMMAND

As soon as you have finished an assignment, submit the completed answer sheet to the officer designated to grade it. The graded answer sheet will not be returned to you.

If you are completing this NRCC to become eligible to take the fleetwide advancement examination, follow a schedule that will enable you to complete all assignments in time. Your schedule should call for the completion of at least one assignment per month.

Although you complete the course successfully, the Naval Education and Training Program Development Center will not issue you a letter of satisfactory completion. Your command will make an entry in your service record, giving you credit for your work.

WHEN YOUR COURSE IS ADMINISTERED BY THE NAVAL EDUCATION AND TRAINING PROGRAM DEVELOPMENT CENTER

After finishing an assignment, go on to the next. Retain each completed answer sheet until you finish all the assignments in a unit (or in the course if it is not divided into units). Using the envelopes provided, mail your completed answer sheets to the Naval Education and Training Program Development Center where they will be graded and the score recorded. Make sure all blanks at the top of each answer sheet are filled in. Unless you furnish all the information required, it will be impossible to give you credit for your work. The graded answer sheets will not be returned.

The Naval Education and Training Program Development Center will issue a letter of satisfactory completion to certify successful completion of the course (or a creditable unit of the course). To receive a course-completion letter, follow the directions given on the course-completion form in the back of this NRCC.

You may keep the textbook and assignments for this course. Return them only in the event you disenroll from the course or otherwise fail to complete the course. Directions for returning the textbook and assignments are given on the book-return form in the back of this NRCC.

PREPARING FOR YOUR ADVANCEMENT EXAMINATION

Your examination for advancement is based on the Occupational Standards for your rating as found in the MANUAL OF NAVY ENLISTED MANPOWER AND PERSONNEL CLASSIFICATIONS AND OCCUPATIONAL STANDARDS (NAVPERS 18068). These Occupational Standards define the minimum tasks required of your rating. The sources of questions in your advancement examination are listed in the BIBLIOGRAPHY FOR ADVANCEMENT STUDY (NAVEDTRA 10052). For your convenience, the Occupational Standards and the sources of questions for your rating are combined in a single pamphlet for the series of examinations for each year. These OCCUPATIONAL STANDARDS AND BIBLIOGRAPHY SHEETS (called Bib Sheets), are available from your ESO. Since your textbook and NRCC are among the sources listed in the bibliography, be sure to study both as you take the course. The qualifications for your rating may have changed since your course and textbook were printed, so refer to the latest edition of the Bib Sheets.

NAVAL RESERVE RETIREMENT CREDIT

This course is evaluated at 18 Naval Reserve retirement points, which will be credited in units as follows: Unit 1: 12 points upon satisfactory completion of Assignments 1 through 6; and, Unit 2: 6 points upon satisfactory completion of Assignments 7 through 9. These points are creditable to personnel eligible to receive them under current directives governing retirement of Naval Reserve personnel. Naval Reserve retirement credit will not be given for this course if the student has previously received retirement credit for an Aviation Support Equipment Technician M/H 3 & 2, NRCC or ECC.

COURSE OBJECTIVE

While completing this course you will demonstrate your understanding of course material by correctly answering items on the following; the AS rating structure, Naval Aviation Maintenance Program (NAMP), publications, Aviation supply system, GSE training, ground support equipment, tools, and test equipment, corrosion control and hardware, fuels, lubricants and hydraulic fluids.

While working on this correspondence course, you may refer freely to the text. You may seek advice and instruction from others on problems arising in the course, but the solutions submitted must be the result of your own work and decisions. You are prohibited from referring to or copying the solutions of others, or giving completed solutions to anyone else taking the same course.

Naval courses may include a variety of questions -- multiple-choice, true-false, matching, etc. The questions are not grouped by type; regardless of type, they are presented in the same general sequence as the textbook material upon which they are based. This presentation is designed to preserve continuity of thought, permitting step-by-step development of ideas. Some courses use many types of questions, others only a few. The student can readily identify the type of each question (and the action required) through inspection of the samples given below.

MULTIPLE-CHOICE QUESTIONS

Each question contains several alternatives, one of which provides the best answer to the question. Select the best alternative, and blacken the appropriate box on the answer sheet.

SAMPLE

s-1. The first person to be appointed Secretary of Defense under the National Security Act of 1947 was
1. George Marshall
2. James Forrestal
3. Chester Nimitz
4. William Halsey

Indicate in this way on the answer sheet:

	1 T	2 F	3	4	
s-1	☐	■	☐	☐	___

TRUE-FALSE QUESTIONS

Mark each statement true or false as indicated below. If any part of the statement is false the statement is to be considered false. Make the decision, and blacken the appropriate box on the answer sheet.

SAMPLE

s-2. Any naval officer is authorized to correspond officially with any systems command of the Department of the Navy without his commanding officer's endorsement.

Indicate in this way on the answer sheet:

	1 T	2 F	3	4	
s-2	☐	■	☐	☐	___

MATCHING QUESTIONS

Each set of questions consists of two columns, each listing words, phrases or sentences. The task is to select the item in column B which is the best match for the item in column A that is being considered. Items in column B may be used once, more than once, or not at all. Specific instructions are given with each set of questions. Select the numbers identifying the answers and blacken the appropriate boxes on the answer sheet.

SAMPLE

In questions s-3 through s-6, match the name of the shipboard officer in column A by selecting from column B the name of the department in which the officer functions.

A	B
s-3. Damage Control Assistant	1. Operations Department
s-4. CIC Officer	2. Engineering Department
s-5. Disbursing Officer	3. Supply Department
s-6. Communications Officer	

Indicate in this way on the answer sheet:

	1 T	2 F	3	4	
s-3	☐	■	☐	☐	___
s-4	■	☐	☐	☐	___
s-5	☐	☐	■	☐	___
s-6	■	☐	☐	☐	___

Assignment 1

Rating Structure & NAMP

Text: Pages 1-1 through 2-22

In this course you will demonstrate that learning has taken place by correctly answering training items. The mere physical act of indicating a choice on an answer sheet is not in itself important; it is the *mental* achievement, in whatever form it may take, prior to the physical act that is important and toward which course *learning objectives* are directed. The selection of the correct choice for a course training item indicates that you have fulfilled, at least in part, the stated objective(s).

The accomplishment of certain objectives, for example, a *physical* act such as drafting a memo, cannot readily be determined by means of objective type course items; however, you can demonstrate by means of answers to training items that you have acquired the requisite knowledge to perform the physical act. The accomplishment of certain other learning objectives, for example, the *mental* acts of comparing, recognizing, evaluating, choosing, selecting, etc., may be readily demonstrated in a course by indicating the correct answers to training items.

The *comprehensive* objective for this course has already been given. It states the purpose of the course in terms of what you will be able to do as you complete the course.

The *detailed* objectives in each assignment state what you should accomplish as you progress through the course. They may appear singly or in clusters of closely related objectives, as appropriate; they are followed by items which will enable you to indicate your accomplishment.

All objectives in this course are *learning* objectives and items are *teaching* items. They point out important things, they assist in learning, and they should enable you to do a better job for the Navy.

This self-study course is only one part of the total Navy training program; by its very nature it can take you only part of the way to a training goal. Practical experience, schools, selected reading, and the desire to accomplish are also necessary to round out a fully meaningful training program.

Learning Objective: Distinguish between general and service ratings, the terms rate and ratings. Identify the type of materials to be studied in preparing for advancement.

1-1. The aviation support equipment technician (AS) rating was first established in which of the following years?
1. 1950
2. 1956
3. 1966
4. 1976

1-2. In what manual are the minimum occupational requirements for advancement in all ratings listed?
1. NAVPERS 10056-D
2. NAVPERS 18068 (Series)
3. NAVEDTRA 10052-W
4. NAVEDTRA 10315-B

1-3. The rating structure for naval enlisted personnel in the AS rating provides for
1. service ratings only
2. general ratings only
3. both general and service ratings
4. general, service, and emergency ratings

1-4. A general rating is one which reflects qualifications in
1. civilian skills identified with a peacetime Navy
2. civilian skills identified with a wartime Navy
3. broad occupational fields of related duties and functions
4. subdivisions or specialties within broad occupational fields

1-5. What term identifies personnel occupationally by pay grade?
1. Rate
2. Rating
3. General rating
4. Billet

1-6. Service ratings exist at PO3 and PO2 levels only and are not applicable to both regular Navy and naval reserve personnel.

1-7. Which of the following rates is a service rating ?
1. ASM2
2. AS1
3. ASCS
4. ASCM

1-8. What ratings have been established in order that personnel may be utilized within the scope of a general rating where specialization is required?
1. Service ratings
2. Special ratings
3. Emergency ratings
4. Reserve ratings

1-9. Refer to figure 1-1 in your textbook. The general rating of Aviation Support Equipment Technician applies to which of the following pay grades?
1. E-4 through E-7
2. E-4 through E-9
3. E-6 through E-9
4. E-8 and E-9 only

1-10. Refer to figure 1-1 in your textbook. At what rate level does the AS have his first opportunity to apply for advancement to Warrant Officer (W-2)?
1. Second class
2. First class
3. Chief petty officer
4. Master chief petty officer

1-11. Aviation Support Equipment Technicians do NOT maintain which type of support equipment?
1. Electric
2. Avionic
3. Hydraulic
4. Pneumatic

1-12. The ASM usually is NOT required to perform maintenance or service on which of the following types of aviation support equipment?
1. Gasoline and diesel engines in self-propelled equipment and associated automotive systems
2. Gas turbine compressor units and air-conditioning systems used in servicing aircraft
3. Gas turbine compressor unit test stands
4. Jet engine test cells

1-13. AS technicians are usually assigned to activities that perform intermediate level maintenance aboard
1. naval air stations
2. aircraft carriers
3. overseas shore stations
4. all of the above

1-14. Studying cancelled or obsolete information will aid you in advancement and performing more effectively because such information is valuable in passing written examinations and in maintaining equipment.

Learning Objective: Recognize and identify the Naval Aviation Maintenance Plan (NAMP) including concepts, objectives, policies, organizations, and responsibilities pertaining to naval aviation.

1-15. The Naval Aviation Maintenance Program (NAMP) was established and implemented by the
1. Secretary of the Navy (SECNAV)
2. Secretary of Defense (SECDEF)
3. President
4. Chief of Naval Operations (CNO)

1-16. The NAMP establishes maintenance policies, procedures and resonsibilities for the performance of aviation maintenance throughout naval aviation and is outlined in which of the following?
1. OPNAVINST 4790.2 (Series)
2. SECNAVINST 4790.2 (Series)
3. AIRLANTINST 4790.2 (Series)
4. PACLANTINST 4790.2 (Series)

In items 1-17 through 1-20, select from column B the volumn(s) most closely related to the title listed in column A.

	A. Titles	B. Volumes
1-17.	Intermediate level maintenance	1. Volumn I
		2. Volumn II
1-18.	Concepts, objectives, policies, organizations and responsibilities	3. Volumn III
		4. Volumn IV
1-19.	Depot level maintenance	
1-20.	Organizational level maintenance	

1-21. Refer to figure 2-2 in your text book. The numeral "04" refers to which of the following?
1. Chapter 4
2. Paragraph 4
3. Section 4
4. Both 1 and 3 above

1-22. As an AS, you can be assigned to aircraft squadrons, aircraft carriers, and naval air stations. What level of maintenance would you perform at an AIMD aboard ship?
1. Organizational
2. Depot
3. Intermediate
4. Both 1 and 3 above

1-23. Major overhaul and modification of GSE performed at industrial type facilities is which of the following levels of maintenance?
1. Organizational
2. Depot
3. Intermediate
4. All of the above

Learning Objective: Identify the organizational structure of different maintenance activites as to divisions and indicate the responsibilites of each.

1-24. In an Organizational Maintenance Department, who is responsible for estimating and programing facilities, equipment, manpower, and training requirements?
1. Supply officer
2. Commanding officer
3. Material officer
4. Maintenance officer

1-25. The administrative, quality assurance/analysis, and maintenance/material central divisions are under the direct supervision of which of the following?
1. Commanding officer
2. Assistant maintenance officer
3. Maintenance officer
4. Supply officer

1-26. In a maintenance department, there are two major types of divisions, which are
1. staff and production
2. staff and supply
3. production and supply
4. staff, production, and supply

1-27. The quality assurance/analysis division is a subordinate division of
1. administrative
2. material control
3. production
4. staff

Learning Objective: Recognize the duties and responsibilities of the quality assurance division.

1-28. The division that an AS would have the most contact with and which is responsible for keeping defects from affecting or interferring with maintenance is
1. production control
2. quality assurance
3. material control
4. both 1 and 3 above

1-29. The achievement of quality assurance depends on which of the following?
1. Safety officer and division officer
2. Production, knowledge, and special skills
3. Quality assurance officer
4. Prevention, knowledge, and special skills

1-30. Which if any, of the following divisions establishes minimum qualifications required for personnel selected for collateral duty inspectors (CDI)?
1. Quality assurance
2. Maintenance control
3. The cognizant division
4. None

1-31. The quality assurance division is manned by highly skilled maintenance personnel who are known as
1. CDIs
2. CDQARs
3. QARs
4. all of the above

1-32. An AS assigned to QA should be which of the following rates?
1. ASM-2
2. AS-1
3. ASE-2
4. ASH-2

1-33. Which of the following division officers is responsible for establishing qualifications for CDIs?
1. Material control officer
2. Quality assurance officer
3. Production division officer
4. Assistant maintenance officer

1-34. When CDIs perform quality assurance functions within the work center, they are responsible to which of the following officers?
1. Division
2. QA
3. Safety
4. Maintenance/material

1-35. OPNAV 4790.2 (Series) clearly states, if there is a shortage of personnel, all CDIs may inspect their own work and sign as inspector.

1-36. The types of audits conducted by quality assurance are
1. work center audits
2. special audit and quarterly audit
3. work center and special audits
4. quarterly and work center audits

1-37. The work center audit conducted by QA should be held at least
1. monthly
2. quarterly
3. semiannually
4. annually

1-38. A duty of the data analyst in the quality assurance/analysis division is to
1. act as a technical librarian
2. perform the MDS functions of the division
3. perform the duties of an auxillary QAR
4. act as a division liaison with maintenance control

1-39. Audits are conducted by quality assurance and provide a means for evaluating the maintenance department as to
1. personnel and their skill
2. compliance with safety/cleanliness regulations
3. calibration of test equipment
4. all of the above

Learning Objective: Identify responsibilities and duties of the maintenance/material control division of an AIMD, in relation to supply, maintenance, and production divisions.

1-40. In an intermediate maintenance activity, which work center is responsible for proper planning, scheduling, and assigning the various maintenance tasks performed?
1. Quality assurance
2. Maintenance control
3. Material control
4. Maintenance administration

1-41. The work center that acts as liaison between the department and the local supply activity is which of the following?
1. Maintenance control
2. Quality assurance
3. Maintenance administration
4. Material control

1-42. Which of the following work centers coordinates, controls, and processes all supply and material requisitons in the department?
1. Material control
2. Maintenance control
3. Maintenance administration
4. Quality assurance

1-43. The standard organizational framework of an intermediate maintenance department allows for how many production divisions?
1. Six
2. Seven
3. Three
4. Four

Learning Objective: Identify types of maintenance actions, inspections, and procedures for documenting maintenance history and custody of GSE.

1-44. The Ground Support Equipment (GSE) division is authorized to perform which of the following types of maintenance actions?
1. Scheduled, level 1 only
2. Unscheduled, level 2 only
3. Scheduled and unscheduled
4. Level 2, but not level 1

1-45. There are how many types of maintenance actions?
1. One
2. Two
3. Three
4. Four

1-46. For an effective scheduled maintenance program, you must have Maintenance Requirements Cards (MRCs). MRCs do NOT contain instructions for
1. periodic inspections
2. repair, adjusting, or corrective action
3. acceptance inspections
4. all of the above

In items 1-47 through 1-49, select from column B the type of inspection associated with each definition in column A.

	A. Definitions	B. Types of Inspections
1-47.	The daily inspection accomplished prior to the first use of the subject equipment for that day	1. Preoperational 2. Special
		3. Acceptance
1-48.	The inspections which are accomplished in intervals of days, weeks, hours, or months	4. Periodic
1-49.	An inventory of all installed and loose material, configuration verification, test of systems, and a thorough preoperational inspection	

1-50. What type of inspection, if any, is performed when a piece of GSE is shipped from one command to another command?
1. Transfer only
2. Acceptance only
3. Both 1 and 2 above
4. None

1-51. The Custody and Maintenance Record is divided into six major sections, four on the front and two on the back, and is maintained to provide a complete maintenance history of each unit of support equipment until the unit is retired.

In items 1-52 through 1-54, select from column B the correct OPNAV form number for the forms listed in column A.

	A. Name of Forms	B. Number of Forms
1-52.	GSE Custody and Maintenance Record	1. OPNAV 4790/51
		2. OPNAV 4790/52
1-53.	GSE Sub-Custody and Periodic Maintenance Record	3. OPNAV 4790/50
		4. OPNAV 4790/60
1-54.	GSE Daily Record	

1-55. Which of the following forms/records is used to record acceptance/ transfer, rework, preservation on GSE?
1. OPNAV 4790/51
2. OPNAV 4790/52
3. OPNAV 4790/2B
4. OPNAV 4790/50

1-56. Which of the following forms is used to record operating and periodic maintenance information?
1. OPNAV 4790/51
2. OPNAV 4790/52
3. OPNAV 4790/50
4. OPNAV 4790/2B

1-57. Entries made on the Sub-Custody and Periodic Maintenance Record, OPNAV Form 4790/50, are the responsibility of the activity having prime custody of the pertinent equipment.

1-58. What may be used to determine the operating time recorded on GSE periodic maintenance records?
1. Hour meters
2. Start meters
3. Daily usage accounting
4. All of the above

1-59. When transferring GSE on a permanent basis, which of the following record(s) must accompany the equipment?
1. GSE Custody and Maintenance Record
2. GSE Daily Record
3. GSE Sub-Custody and Periodic Maintenance Record
4. Both 1 and 3 above

Learning Objective: Identify Maintenance Data Reporting (MDR) and the codes associated with each.

1-60. Maintenance Data Reporting (MDR) is used to produce reports for the management and improvement of
1. material
2. equipment design
3. maintenance and supply
4. all of the above

In items 1-61 through 1-63, select the most correct defintion in column B, for the terms listed in column A.

	A. Terms		B. Definitions
1-61.	Maintenance Action	1.	Maintenance performed on complete items
1-62.	Off-equipment work	2.	Maintenance that consumes man-hours/material
1-63.	On-equipment work	3.	Maintenance performed on removed items

---

1-64. An alphabetic/numeric code that consists of five or seven characters and known as a Work Unit Code (WUC) identifies which of the following?
1. System/subsystem
2. Assembly/component
3. Type of equipment/unit
4. Both 1 and 3 above

1-65. The code used to describe equipment malfunctions and consists of three characters is the
1. Work Unit Code
2. When Discovered Code
3. Action Taken Code
4. Malfunction Code

1-66. The code used when reporting repairable items found to be nonrepairable at the intermediate maintenance level are referred to as the
1. Support Action Code
2. Action Taken Code
3. Work Unit Code
4. When Discovered Code

1-67. Support Action Codes are used to identify
1. removed and replaced material
2. routine, repetitive maintenance action
3. nonrepairable material
4. all of the above

1-68. Type Maintenance Codes are used to describe the type of work being accomplished. Calibration of precision measuring equipment is coded
1. A
2. P
3. C
4. B

1-69. Which of the following codes reflects the type of data being reported?
1. Type Equipment
2. Transaction
3. Type Maintenance
4. Support Action

1-70. As an AS, the Type Equipment Code you will most commonly use is which of the following series?
1. A
2. B
3. G
4. P

1-71. The Type Equipment Code used for the NC-2A Mobile Electic Power Plant (MEPP) is
1. GAC6
2. GACG
3. GACB
4. GACA

1-72. The handbooks H4-1 and H4-2 published by Defense Logistics Service Center is a cross reference listing of
1. Type Equipment Codes and names
2. manufacturer's codes and names
3. Type Maintenance Codes
4. both 1 and 3 above

Assignment 2

NAMP and Publications

Text: Pages 2-22 through 3-13

Learning Objective: Recognise and identify the VIDS/MAF and SAF's used to report maintenance action, including the codes used.

2-1. A four-digit number that identifies the year and numerical day of the year is known as the
1. job control number
2. suffix number
3. Julian date
4. elapsed maintenance date

2-2. The Job Control Number (JCN) allows separate identification of each maintenance action and is composed of
1. the organization code
2. the day
3. the serial number
4. all of the above

2-3. The Visual Information Display System/Maintenance Action Form (VIDS/MAF) used primarily for organisaitonal level maintenance is OPNAV Form
1. 4790/52
2. 4790/60
3. 4790/59
4. 4790/61

2-4. The VIDS/MAF used primarily by organizational and intermediate maintenance level activities is OPNAV Form
1. 4790/52
2. 4790/60
3. 4790/59
4. 4790/61

2-5. The work center MDR verification copy 5 is used for the work center daily audit.

In items 2-6 through 2-9 from column B, match the correct copy of the 5-part VIDS/MAF to its intended use listed in column A (I-level maintenance).

A. Uses	B. VIDS/MAFs
2-6. Work center register	1. Copy 1
2-7. Ready For Issue (RFI)	2. Copy 2
2-8. Supply Department Register	3. Copy 3
	4. Copy 4
2-9. Production Control Register	

2-10. Which of the following persons is authorized to sign the "Inspection By" block on a VIDS/MAF?
1. The technican performing the job
2. The work center supervisor
3. A technician not directly involved with the task
4. A quality assurance representative

2-11. Support Action Forms (SAFs) are used to report which of the following?
1. Nonrepetitive maintenance actions
2. Scheduled maintenance actions
3. Repetitive maintenance actions
4. All of the above

2-12. Who must sign a SAF to indicate that screening has been completed?
1. Worker/crew leader
2. Work center supervisor
3. Division chief
4. Data analysis representative

Learning Objective: Identify publications pertinent to the GSE work center as to type and use and indicate related procurement, updating, and identification procedures.

- In answering items 2-13 through 2-25 match the correct VIDS/MAF block title to the VIDS/MAF block number, as you refer to the text and figure 2-13.

2-13. Work Unit Code
1. A-22
2. A-29
3. A-32
4. A-34

2-14. Manhours
1. A-22
2. A-32
3. A-34
4. A-41

2-15. Action organization
1. A-22
2. A-29
3. A-32
4. A-34

2-16. Transaction Code
1. A-32
2. A-22
3. A-29
4. A-36

2-17. Maintenance level
1. A-34
2. A-36
3. A-35
4. A-41

2-18. Action Taken Code
1. A-36
2. A-35
3. A-41
4. A-22

2-19. Malfunction Code
1. A-29
2. A-34
3. A-36
4. A-48

2-20. Items Processed
1. A-58
2. A-59
3. A-39
4. A-52

2-21. Type Equipment Code
1. A-36
2. A-48
3. A-45
4. A-39

2-22. When Discovered
1. A-22
2. A-36
3. A-35
4. A-58

2-23. Elapsed maintenance time
1. A-29
2. A-36
3. A-48
4. A-45

2-24. Type Maintenance Code
1. A-45
2. A-59
3. A-39
4. A-52

2-25. Bureau/Serial Number
1. A-58
2. A-45
3. A-39
4. A-52

2-26. Aeronautic publications that deal with operations and maintenance of ground support equipment are issued by the authority of the
1. Chief of Naval Operations (CNO)
2. Secretary of the Navy (SECNAV)
3. Naval Air System Command (NAVAIR)
4. Aircraft controlling custodian (ACC)

2-27. Technical manuals and other data pertaining to naval aviation are managed and distributed by the commanding officer of the
1. Naval Air Systems Command (NAVAIR)
2. Naval Air Technical Services Facility (NAVAIRTECHSERVFAC)
3. Naval Aeronautic Publications Command (NAVAIRPUBCOM)
4. all of the above

2-28. Technical manuals do not provide current authoritative information about material upkeep, checks, tests, and repairs on equipment. Therefore personnel responsible for the operation and maintenance of GSE need not be thoroughly familiar with them.

2-29. Publications known as aeronautic publications and issued by NAVAIR are divided into which of the following categories?
1. Technical manuals
2. Technical directives
3. Engineering drawings and associated data
4. All of the above

2-30. The information contained in aeronautic publications is
1. general
2. specific
3. both 1 and 2 above
4. none of the above

2-31. A document containing supplemental information for aeronautic manuals that is issued periodically is called a

1. letter-type technical directive
2. notice or technical order
3. bulletin or notice
4. technical change

2-32. The listing of manuals that are available on specific items of aeronautical equipment is found in which of the following?

1. Navy Stock List of Forms and Publications, NAVSUP 2002
2. Equipment Applicability List, NAVAIR 00-500A
3. Aircraft Application List, NAVAIR 00-500B
4. Directives Application List, NAVAIR 00-500C

2-33. How is the NAVAIR 00-500A kept current?

1. By semiannual reissue and monthly supplements
2. By annual reissue and quarterly supplements
3. By quarterly reissue and monthly supplements
4. By quarterly supplements only

2-34. Which of the following publications has the cross-reference index listings of NAVAIR publications according to model/type/part number?

1. Numerical Index
2. Equipment Applicability List
3. Aircraft Application List
4. Directives Application List by Aircraft Configuration

● Refer to Figure 3-1 in answering questions 2-35 through 2-39.

2-35. The column, model/type/part number, lists all items of equipment by

1. alphabetical sequence
2. numerical sequence
3. alphanumerical sequence
4. nomenclature/description

2-36. The 5-digit code that identifies the contractor and/or government agency that manufactured the item of equipment is listed in the column headed

1. model/type/part number
2. nomenclature
3. vendor
4. any of the above

2-37. In which column/heading of the NAVAIR 00-500A do you find a descriptive term for equipment listed?

1. Vendor
2. Nomenclature
3. Model/type/part number
4. Supplemental remarks

2-38. If a model/type/part number is being supplemented with other part number information, in which column is an entry made?

1. Supplemental part number data
2. Supplemental remarks
3. Model/type/part number
4. Nomenclature

2-39. Under the column heading of Security Classification (SC), which of the following letters indicate that a technical manual is classified?

1. C and U
2. S and C
3. S and U
4. Any combination of the above

2-40. A complete list of manual types and their corresponding codes can be found in the introduction of Volume 1 of

1. NAVAIR 00-500A
2. NAVAIR 00-500B
3. NAVAIR 00-500C
4. NAVSUP 2002

2-41. Before ordering a technical manual, to obtain the complete publication title, date, and requisition restriction code, you should refer to

1. NAVAIR 00-500A
2. NAVSUP 2002
3. NAVAIR 00-500B
4. NAVAIR 00-500C

2-42. How is NAVAIR 00-500B kept current?

1. By annual reissue with no supplements
2. By semiannual reissue with monthly supplements
3. By letter-type directives, as occurring
4. By bimonthly addendums

2-43. What is the general subject classification number for Ground Servicing and Automotive Equipment?

1. 11
2. 12
3. 16
4. 19

2-44. The subject classification of publications in group 17 is
1. general
2. powerplants
3. accessories
4. machinery, tools, and test equipment

2-45. A listing of NAVAIR letter-type directives is found in
1. NAVAIR 00-500A
2. NAVAIR 00-500B
3. NAVAIR 00-500C
4. NAVAIR 00-500D

2-46. The NAVAIR 00-500M is divided into how many parts?
1. One
2. Two
3. Three
4. Four

The cartridge number system for ground support equipment is different from those for aircraft. In items 2-47 through 2-50, select from column B the correct definition for cartridges listed in column A.

	A. Cartridges	B. Equipment
2-47.	SE-1	1. Power generation and supply
2-48.	SE-2	
2-49.	SE-3	2. Servicing equipment
2-50.	SE-4	3. Handling equipment
		4. Testing, checking, calibrating, inspecting

2-51. Refer to figure 3-2. The number listed after the decimal point indicates the maintenance level. Which of the following numbers indicate intermediate level maintenance?
1. .653
2. .755
3. .122
4. .401

2-52. Which of the following publications is a cross-reference for Support Equipment Changes (SEC)?
1. NAVAIR 00-500M
2. NAVAIR 00-5005E
3. NAVAIR 00-500A
4. NAVAIR 00-500B

2-53. Which publication is principally used for ordering forms and publications?
1. NAVSUP 2002
2. NAVAIR 2002
3. NAVAIR 00-500C
4. NAVSUP 00-500C

2-54. Which of the following items of information is contained in Section I of the NAVSUP 2002?
1. Instructions and notices
2. Manual-type publications
3. Technical directives
4. All forms used by the Navy

2-55. Which of the following items of information is contained in Section II of the NAVSUP 2002?
1. Manual-type publications
2. All forms used by the Navy
3. Instructions and notices
4. Technical directives

2-56. Which of the following items of information is contained in Section III of the NAVSUP 2002?
1. Instructions and notices
2. Manual-type publications
3. Technical directives
4. All forms used by the Navy

2-57. New microfiche editions of NAVSUP 2002 are issued
1. monthly
2. quarterly
3. semiannually
4. annually

Learning Objective: Identify methods for numbering both manual- and letter-type publications and recognize what is indicated by various parts of the manual classification code.

2-58. What prefix is assigned to publications originated by the Naval Air Systems Command?
1. Air Force Navy (AN)
2. NAVAER (NA)
3. NAVAIR (NA)
4. NAVWEPS (NW)

2-59. Part II of the manual-type publications code number designates which of the following?
1. A specific group/class
2. A specific manufacturer
3. A specific type/model
4. All of the above

2-60. Part III of the manual-type publications code number designates which of the following?
1. A particular group
2. A specific manufacturer
3. A specific manual
4. A general manual

2-61. How are letter-type publications changes numbered that relate to all support equipment?
1. By Julian date
2. By calendar date
3. In number sequence
4. In alphanumeric sequence

2-62. How are letter type materials pertaining to support equipment numbered?
1. Consecutively according to specific application
2. Numerically according to general classification
3. Consecutively according to subject matter
4. In either of the systems listed in 1 and 3 above

2-63. When they are available for issue, all manuals and letter materials, EXCEPT instructions and notices, are assigned code numbers and are listed in the
1. Navy-Air Force Publications Index
2. Naval Aeronautic Publications Index
3. Navy-Air Force Publications Instruction
4. Naval Aeronautic Publications Instruction

2-64. Instructions and notices are NOT listed in which of the following?
1. NAVAIRINST 5215
2. Naval Aeronautic Publications Index
3. NAVSUP 2002
4. Both 1 and 3 above

Learning Objective: Identify the regulation governing security of classified publications, and procedures relating to the reissue and the one-time issue of aeronautical publications.

2-65. The Department of the Navy Security Manual for Classified Information, which governs the safeguarding of classified information relative to all military and civilian personnel and the activities of the naval establishment, is issued as OPNAV Instruction 5510.1 (Series) by the Chief of Naval Operations.

2-66. The Department of the Navy Information Security Program Regulation, OPNAV Instruction 5510.1 (Series), is issued by
1. SECNAV
2. CNO
3. DOD
4. NAVAIRSYSCOM

2-67. The provisions of OPNAV 5510.1 (Series) apply to
1. civilian personnel only
2. enlisted personnel only
3. officer personnel only
4. every person and every activity in the naval establishment

2-68. Security classifications appearing on printed manuals or NAVSUP 2002 apply only to which of the following?
1. Equipment covered in the manual
2. Information contained in the manual
3. Both 1 and 2 above
4. Personnel using the manual

In items 2-69 through 2-71, select from column B the procurement method that is most closely associated with each statement listed in column A.

A. Statements

2-69. Aeronautical publications are provided by the Naval Technical Service Facility (NATSF) to a newly commissioned NAS.

2-70. A request is made that future issues of a particular publication be received by the AIMD of a NAS.

2-71. DD Form 1348 is submitted by an AIMD officer for a particular publication

B. Procurement Methods

1. Automatic distribution list
2. Ordering direct
3. Initial outfitting
4. Outfitting allowance

Assignment 3

Publications and Supply

Text: Pages 3-13 through 4-5

Learning Objective: Identify by the content aviation publications which provide information beneficial to maintenance personnel.

3-1. Which of the following publications is NOT published for general distribution but provides useful and timely information for commanders and other authorized personnel?
1. Crossfeed
2. Approach
3. Naval Aviation News
4. Digest of U.S. Naval Aviation Weapons

3-2. If an AS wants to obtain the most accurate current information on the subject of accident prevention, what should he read?
1. Approach
2. Naval Aviation News
3. The applicable Crossfeeds
4. MECH

Learning Objective: Recognize manual type publications of special interest to the AS, including their contents, uses, originators, identification markings, and updating procedures.

3-3. Allowance Lists are included in what series of publications in the Naval Aeronautic Publications Index?
1. 00
2. 03
3. 17
4. 19

3-4. Repair parts, nuts, bolts, etc. are included in which of the following publications?
1. Data Material List
2. Initial Outfitting List
3. Allowance Lists
4. Aircraft Material List

3-5. Data and documentation needed to determine and establish support equipment requirements and inventory control of ground support equipment are provided in the
1. Application Data Material Readiness List (ADMRL)
2. Aeronautical Allowance List
3. Aircraft Maintenance Material Readiness List (AMMRL)
4. Individual Material Readiness List (IMRL)

3-6. The initial list established by NAVAIR that specifies requirements for each item of aircraft maintenance support equipment at each level of maintenance is which of the following?
1. Individual Material Readiness List (IMRL)
2. Application Data Material Readiness List (ADMRL)
3. Aircraft Maintenance Material Readiness List (AMMRL)
4. Aeronautical Allowance List (AAL)

3-7. Which of the following material readiness lists specifies the types and amounts of ground support equipment required to maintain material readiness of the maintenance activity to which the list applies?
1. Individual Material Readiness List (IMRL)
2. Application Data Material Readiness List (ADMRL)
3. Aircraft Maintenance Material Readiness List (AMMRL)
4. Master Cross-Reference List (MCRL)

3-8. Which of the manual-type publications series shown in table 3-1 are of special importance to the AS?
1. 00, 17, and 19
2. 00, 02, and 17
3. 01, 02, and 19
4. 02, 03, and 17

3-9. After the support equipment manuals are prepared by the manufacturer, who has the authority to issue them?
1. The Naval Ship Systems Command
2. The Naval Air Systems Command
3. The Naval Material Command
4. Any of the above

3-10. Support Equipment Manuals contain detailed instructions for performing
1. maintenance and repair
2. service and inspection
3. operation and overhaul
4. all of the above

3-11. Which section of the Operation and Service Instructions Manual usually contains a table of specifications for the equipment's systems?
1. I
2. II
3. III
4. IV

3-12. What information is NOT included in the operating procedures section of the Operating and Servicing Instructions for an item of support equipment?
1. The principles of operation
2. The preparation of the unit for use
3. The purpose and use of the operating controls
4. The purpose and use of the indicating instruments

3-13. What means is usually used in the pertinent Operating and Service Instructions section to indicate the inspection intervals of a component or system of support equipment?
1. Tables
2. Diagrams
3. Charts
4. Either 1 or 3 above

3-14. When an AS performs periodic inspections, what section of the Operations and Service Instructions should he use along with the Maintenance Requirements Cards?
1. Operating Instructions
2. Illustrated Parts Breakdown
3. Overhaul and Repair
4. Service Instructions

3-15. The manuals that contain repair or overhaul instructions for support equipment are usually issued at which of the following maintenance levels?
1. Organizational
2. Intermediate
3. Depot
4. All of the above

3-16. What publication is designed to aid maintenance personnel in identifying and ordering replacement parts?
1. Overhaul Instructions Manual
2. Service Instructions Manual
3. Illustrated Parts Breakdown (IPB)
4. Maintenance Instructions Manual

3-17. Which of the IPB sections contains information that will aid an AS in locating parts quickly and easily?
1. The Introduction
2. The Group Assembly Parts Lists
3. The Numerical Index
4. Any of the above

3-18. The Numerical Index of the IPB contains information pertaining to
1. National Stock Number data
2. figure and index numbers
3. source data and repair codes
4. all of the above

3-19. The NAVAIR Manual that is required reading for all personnel performing hydraulic maintenance functions on naval aircraft and GSE is designated
1. NA-17-1A-01
2. NA-00-80T-96
3. NA-17-08-42
4. NA-01-1A-17

Select from column B, the NAVAIR publication that relates most closely to the statement in column A.

A. Statements	B. Publications
3-20. Contains information on the repair and testing of tiedown chains	1. NAVAIR 17-1-114
3-21. Pertains to GSE cleaning and corrosion	2. NAVAIR 17-1-125
3-22. Pertains to aircraft corrosion controls	3. NAVAIR 01-1A-509

3-23. What is the subject classification of the publication NAVAIR 19-45-1?
1. Index and application tables for aircraft jacks
2. Index and application tables for mobile electric power plants
3. Index and application tables for tow tractors
4. All of the above

3-24. Which code number in manual-type publications identifies the subject breakdown pertaining to aircraft hydraulic jacks?
1. 19-10
2. 19-20
3. 19-70
4. 19-80

3-25. MIL-HDBK-300B provides a consolidated source of descriptive information about individual items of ground support equipment used by the Navy, Air Force, and Army.

3-26. Changes to publications that are held by production divisions are incorporated into the publications by personnel of the
1. Administrative Division
2. technical library staff
3. Quality Assurance Division
4. respective work centers

3-27. Changes or revisions to manuals may be issued in which of the following forms?
1. Write-in material
2. Replacement or additional pages
3. Supplemental data
4. 1 and 2 above

3-28. If an AS in a work center files a page of technical information next to an affected page in a publication, what type of change is he incorporating?
1. Write-in
2. Replacement
3. Supplement data
4. Duplicate change

3-29. Which of the following statements correctly describes a supplementary page numbered 5-65A and the information thereon?
1. It is placed between pages 5-65 and 5-66, and may apply to either of those pages, but not to both
2. It is placed between pages 5-65 and 5-66, and may apply to either or both of those pages
3. It is placed after page 5-64, and applies only to page 5-65
4. It is placed between pages 5-65 and 5-66, and applies only to page 5-65

3-30. Where is the issue date of a replacement page in a manual noted?
1. On the back of the manual's cover page
2. On the bottom of the replacement page
3. On the back of the replacement page
4. On the front of the manual's cover page

3-31. The currentness and completeness of a manual can be determined by checking the change notice cover page list and date of issue pertaining to each change against the corresponding page of the manual.

3-32. The Rapid Action Change (RAC) system has been developed to get urgently required information to the field that affects which of the following?
1. Hazards to personnel
2. Flight safety
3. Aircraft or equipment damage
4. All of the above

3-33. Normally, a routine change must be incorporated in a manual within how many working days?
1. Two
2. Four
3. Three
4. Five

Learning Objective: Identify types, contents, purposes, and procedures associated with letter-type publications.

3-34. What type of directive should be used if material of a technical nature needs to be disseminated?
1. Change or Bulletin
2. Bulletin or Notice
3. Technical Note or Change
4. Notice or Technical Order

3-35. Of the following directives, the one that would be classified as a Bulletin is the one which contains instructions and directions to
1. install a specified workstand component
2. correct a safety or operational condition
3. perform initial tests to determine if a given condition exists
4. modify the parts of a specified pneumatic system

3-36. What type of technical directive is disseminated by means of a message?
1. Notice
2. Interim Change or Bulletin
3. Technical Note
4. Technical Order

3-37. Which type of directive is used when it is necessary to revise or amend an existing technical directive?
1. Change
2. Revision
3. Bulletin
4. Amendment

3-38. Which type of directive is identified as a completely new edition of an existing directive?
1. Amendment
2. Reissue
3. Revision
4. Change

3-39. Interim Bulletins are self-rescinding with rescission dates and remain in effect until
1. the end of the month in which they were issued
2. the indicated time for their cancellation occurs
3. all requirements have been incorporated and recorded
4. the end of the year, at which time they are automatically canceled

3-40. What type of action is assigned to a directive issued to correct safety conditions which, if left uncorrected, could result in the loss of life or equipment?
1. ROUTINE
2. URGENT
3. IMMEDIATE
4. Any of the above

Refer to table 3-4 in your textbook in answering items 3-41 through 3-43. Select from column B the proper time frame for compliance for each type of directive listed in column A.

	A. Type Directives		B. Time Frames
3-41.	Immediate (Formal)	1.	Prior to further use
3-42.	Urgent (Interim)	2.	Not later than next regularly scheduled rework
3-43.	Routine (Formal)	3.	Within 18 months of date of issue
		4.	Not later than 120 days from date of issue

Learning Objective: Identify how the Technical Publications Library (TPL) and the Maintenance Information Automated Retrieval System (MIARS) function.

3-44. The central location that determines, receives, distributes and controls the technical publication that is required to maintain GSE is known as the
1. Divisional Dispersed Library
2. Technical Research Library
3. Technical Material Library
4. Technical Publications Library

3-45. All publications should be placed in binders and filed by publication number by what method(s)?
1. Numerically
2. Alphanumerically
3. Alphabetically
4. All of the above

3-46. The system that projects and prints out information from maintenance manuals is known as
1. NWPL
2. MIARS
3. NATOPS
4. Both 1 and 3 above

3-47. The delay between the time a technical manual change is issued and the time that change is translated into a repair action is known to the AS as
1. warning time
2. danger time
3. lagging time
4. safety time

3-48. To use the microfilm cartridges of the MIARS system, you need which of the following piece(s) of equipment?
1. AR-150A only
2. AR-151A only
3. AR-153A only
4. Both 1 and 2 above

Learning Objective: Indicate the AS's need for a working knowledge of the Navy supply system, and recognize its primary objective, development, organization, and functions.

3-49. It is necessary for the AS to have a working knowledge of the Navy's supply system so that he will be able to

1. order parts for maintenance
2. coordinate the material support of maintenance
3. ensure proper use of materials within his area of responsibility
4. do all the above

3-50. In what way, if any, is the Aviation Supply Office (ASO) related to NAVAIR?

1. It is under the technical control of NAVAIR
2. It is under the management control of NAVAIR
3. It operates independently of NAVAIR
4. It is under the management and technical control of NAVAIR

3-51. Which of the following is a function of the Aviation Supply Office?

1. Administering the sale of surplus Navy property
2. Authorising and supervising the transportation of Navy property
3. Coordinating the compilation of and contracting for the printing of the Catalog of Naval Material
4. Procurement, custody, and issuance of aeronautical spare parts and technical material

3-52. The Commander of the Naval Supply Systems Command is appointed by the

1. President of the United States
2. Secretary of Defense
3. Secretary of the Navy
4. Chief of Naval Operations

3-53. The authority of the Commander of Naval Supply Systems Command is delegated to him by the

1. President of the United States
2. Secretary of the Navy
3. Chief of Naval Operations
4. United States Senate

3-54. Of the general functions listed below, which of the following is NOT a function of ASO?

1. Supervising the procurement, receipt, custody, warehousing and issuance of Navy supplies and materials
2. Preparing budget estimates and administering funds for the supply distribution system
3. Procuring and distributing complete aircraft and engines
4. Rendering an annual report to Congress

Learning Objective: Identify how funds are appropriated and the types and uses of budgets that are allocated.

3-55. Funds are released to agencies of the federal government from the General Fund of the Treasury following which action?

1. Presidential approval for SECDEF action
2. Presidential approval for Treasury Department action
3. Congressional action with presidential approval
4. The House of Representatives action with presidential approval

3-56. Who allots the operating funds for stations and rework facilities?

1. NALC
2. NAVAIR
3. ASO
4. NAVMAT

3-57. Which source of funds is of most concern to an AS assigned to a squadron aboard an aircraft carrier?

1. Operating Target (OPTAR)
2. Operating and Maintenance allotment
3. Aviation Fleet Maintenance allotment
4. APA allotment

3-58. What disposition is made of unused OPTAR funds when a new OPTAR is authorized?

1. They are used as in-excess funds with the new OPTAR
2. They are reverted to the control of the Chief of Naval Operations
3. They are returned to the type commander's control
4. Any of the above may occur, depending upon the original source of the funds

3-59. The type of OPTARS that are of most interest to the AS are those allocating funds for

1. flight operations
2. aircraft research
3. station operation
4. aircraft maintenance

3-60. Aircraft maintenance funds are used at which of the following maintenance level(s)?

1. Organizational
2. Intermediate
3. Organizational and Intermediate
4. Depot

Learning Objective: Indicate methods and publications used in identifying material to be procured, and interpret identifying data.

3-61. The Aircraft Maintenance Material Readiness List program (AMMRL) is used for which of the following purposes?
1. To establish allowance requirements for GSE at the intermediate or organizational maintenance activities
2. To redistribute in-use assets and to evaluate material readiness
3. To establish a base for GSE budget requirements
4. To do all of the above

3-62. The required material readiness list of an activity is the applicable
1. Application Data Material Readiness List (ADMRL)
2. Individual Material Readiness List (IMRL)
3. Aeronautical Allowance List
4. Aircraft Maintenance Material Readiness List (AMMRL)

3-63. All repairable GSE listed on the Individual Material Readiness List (IMRL), in addition to all other GSE costing $200 or more, is assigned a report code of
1. C
2. R
3. A
4. either 1 or 2 above

3-64. Excess in-use accountable GSE is classified as such by which of the following criteria?
1. An authorized IMRL item which is not needed in the allowed quantity
2. A quantity that exceeds the authorized IMRL quantity
3. Any GSE that has been deleted from an activity's IMRL
4. All of the above

3-65. Which activity has the responsibility for the continual review and updating of aeronautical allowance registers?
1. ASO
2. NAVSUP
3. NAVAIR
4. DCNO (Air)

Assignment 4

Supply and Training

Text: Pages 4-5 through 5-7

Learning Objective: Identify functions of maintenance activity material control work centers, and recognize procedures and priority codes used in requisitioning and turning in material.

4-1. A material control work center functions to
1. ensure that maintenance requirements for parts and material are properly forwarded to SSC
2. ensure that parts and material received are expeditiously routed to applicable work centers
3. act as liaison between the maintenance department and the local supply activity
4. do all of the above

4-2. When a support equipment component is received in an Intermediate Maintenance Activity for repair, the administrative screening unit of the material control division performs all except which of the following functions?
1. It schedules repair of the component
2. It positively identifies the component
3. It determines whether repair of the component is within the repair capabilities of the activity
4. It ensures that all logs, records, and VIDS/MAFs are affixed to the component

4-3. The Supply Support Center (SSC) is an internal organization of the local supply activity and is made up of which of the following sections?
1. Component Control Section (CCS)
2. Supply Response Section (SRS)
3. Supply Screening Unit (SSU)
4. Both 1 and 2 above

In items 4-4 through 4-7, select from column B the section of the SSC that is responsible for each function listed in column A.

	A. Functions	B. Sections
4-4.	Maintains records on the status of all LRCA storage components	1. Supply response (SRS)
4-5.	Physically delivers RFI material to the maintenance organization	2. Component control (CCS)
4-6.	Initiates disposition action on components which the local intermediate maintenance activity cannot repair	
4-7.	Accounts for all components being processed in the Intermediate Maintenance Activity	

4-8. The assignment of which force/activity designator can NOT be delegated to Fleet Commanders?
1. I
2. II
3. III
4. IV

4-9. What priorities must FAD III activities submit when making requisitions for corresponding requirements?
1. 1 and 4
2. 2 and 5
3. 3 and 6
4. 7 and 9

● Refer to figure 4-1 in your textbook to answer question 4-10.

4-10. What will be the urgency-of-need designator for parts needed for the emergency repair of an aircraft?

1. I
2. II
3. A
4. D

4-11. Establishment of the National Stock Numbering System resulted in the

1. provision for central storage facilities for similar items
2. provision for automatic like-item delivery to all of the services simultaneously
3. elimination of duplication of items between the services
4. elimination of the services competing against each other for items

4-12. What identification should be used on items that are procured from Navy supply activities by Air Force supply activities?

1. Navy code numbers
2. National stock numbers
3. Either national stock numbers or Navy code numbers
4. Both Navy stock numbers and Navy code numbers

4-13. What part of this NSN identifies the federal supply classification (FSC)?

1. BF
2. 123
3. 4567
4. 1560

● Refer to figure 4-3 in your textbook in answering questions 4-14 and 4-15.

4-14. What information is given by the cognizance symbol 2R?

1. The item is aeronautical equipment and controlled by ASO
2. The item is aeronautical equipment and controlled by NAVAIR
3. The item is consumable photographic equipment controlled by ASO
4. The item is photographic equipment and controlled by NAVAIR

4-15. What prefix used with a national stock number designates the activity that controls publications?

1. 1I
2. OI
3. 2R
4. 8R

● Refer to figure 4-4 in your textbook in answering items 4-16 and 4-17.

4-16. What letter of the material control code indicates that the material can be repaired by a depot maintenance activity?

1. F
2. H
3. R
4. X

4-17. What code classifies material in terms of readiness for issue and use, or identifies action under way to change the status of material?

1. Material control
2. Material condition
3. Source code
4. Recoverability code

4-18. The material condition code of a national stock number may change occasionally throughout the life of an item of material because

1. its national supply classification number may change
2. the serviceable use of the item may change
3. the service employment of the item may differ from its intended employment
4. the item may be transferred periodically between the armed services

4-19. How many material condition codes are assigned to Navy material?

1. 7
2. 9
3. 11
4. 13

4-20. What publication is prepared by the manufacturer and designed to enable supply and maintenance personnel to identify and order replacement parts for specific models of equipment?

1. Navy Management Data List
2. Illustrated Parts Breakdown
3. Support Equipment Reference List
4. Illustrated Shipboard Shopping Guide

4-21. In which section of an IPB can you find general information about a piece of equipment, contents, and instructions on how to use the IPB?

1. Introduction
2. Group Assembly Parts Lists
3. Numerical Index
4. Reference Designation Index

4-22. In which section of an IPB can you find coded information pertaining to the breakdown of a complete unit?

1. Introduction
2. Group Assembly Parts List
3. Numerical Index
4. Reference Designation Index

4-23. Which section of an IPB lists part numbers in alphanumerical order?
1. Introduction
2. Group Assembly Parts List
3. Numerical Index
4. Reference Designation Index

4-24. The Management Data List does NOT include information concerning which of the following?
1. Changes in stock numbers
2. The cost of an item
3. Item shelf life
4. A catalog of material

4-25. Which of the following publications should you NOT use in conjunction with the NMDL to obtain an NSN and/or other types of information for making the most effective use of the NMDL?
1. Descriptive/Identification Lists and Illustrated Shipboard Shopping Guides
2. Support Equipment Reference Lists
3. Deleted and Superseded NIIN List
4. Group Assembly Parts List

Learning Objective: Recognize definitions and uses of SM&R codes.

4-26. How many positions make up the SM&R codes?
1. 5
2. 2
3. 3
4. 4

In questions 4-27 through 4-29, select from column B the item to which each source code in column A refers.

	A. Codes	B. Items
4-27.	PF	1. Item to be manufactured or fabricated at organizational level
4-28.	MO	2. Item to be manufactured or fabricated at intermediate levels ashore
4-29.	AH	3. Item to be assembled at intermediate level ashore
		4. Support equipment which will not be stocked but will be centrally procured on demand

4-30. What repair kit contains cure-dated items such as diaphragms, packings, and O-rings?
1. A-kit
2. C-kit
3. D-kit
4. F-kit

4-31. Which kit provides hardware repair parts only to activities authorized to perform major overhaul?
1. A-kit
2. C-kit
3. D-kit
4. F-kit

4-32. The inventory at any one outlet for preexpended bins will not exceed an estimated supply of how many days?
1. 10 days
2. 20 days
3. 30 days
4. 40 days

Learning Objective: Recognize the different types of parts kits available, the operation of preexpended bins, and material turn-in procedures.

4-33. Who has the primary responsibility for the proper management and maintenance of preexpended bins, including display, labeling, and replenishment when required?
1. Commanding Officer
2. Maintenance Officer
3. Supply Officer
4. Material Officer

4-34. Preexpended bins are inventoried by the supply department a minimum of
1. once a week
2. twice a week
3. once a month
4. twice a month

4-35. At the present time, there is NO provision or requirement for the turn-in of damaged, worn-out, or excess material to the supply department.

4-36. Which copy of the VIDS/MAF is kept by supply for bookkeeping purposes?
1. One
2. Two
3. Three
4. Four

4-37. When repair is completed by AIMD, which copy of the VIDS/MAF is attached to the RFI item that is returned to the supply system?
1. Five
2. Two
3. Three
4. Four

4-38. You, as an AS, can contribute to material management by ensuring that
1. only necessary replacement parts are ordered
2. replacement parts are installed "ASAP"
3. defective parts are turned in to supply "ASAP"
4. each of the above is accomplished

4-39. The training of naval personnel is such a necessary function that it is considered as an important responsibility of which of the following?
1. First Class Petty Officers
2. Second Class Petty Officers
3. Third Class Petty Officers
4. All of the above

Learning Objective: Recognize the importance of, and procedures for, organizing and administering a GSE training program and for licensing personnel for operating GSE.

4-40. What military requirements correspondence course must you complete for advancement to AS1?
1. NAVEDTRA 10325 (Series)
2. NAVEDTRA 10314 (Series)
3. NAVPERS 10057 (Series)
4. NAVEDTRA 10321 (Series)

4-41. Which of the following groups is LEAST representative of actions required by a petty officer in establishing and administering a training program?
1. Selecting instructors, scheduling training periods, and lesson planning
2. Procuring training aids, qualifying instructors, and arranging for classrooms
3. Scheduling training periods, procuring visual training aids, and selecting and qualifying instructors
4. Determining that a training program is needed, lesson planning, and selecting and training instructors

4-42. Which of the following types of subject matter should be included in a GSE training program?
1. GSE licensing program
2. Advancement requirements
3. Maintenance requirements
4. All of the above

4-43. Which of the following statements concerning training for AS personnel is correct?
1. Before an AS may be advanced, he must demonstrate proper teaching techniques
2. Because of varying workloads, no attempt should be made to schedule training on a prearranged schedule
3. An AS must properly use training aids in teaching a class before he is eligible for advancement
4. The major subject areas of work center training are advancement and ground support equipment maintenance

4-44. What are the two types of training concepts?
1. Formal and informal
2. Scheduled and unscheduled
3. Scheduled and formal
4. Unscheduled and informal

4-45. Who is responsible for preparing a lesson plan for shop training?
1. The division officer
2. The division CPO
3. The division LPO
4. The instructor

4-46. The primary purpose of a lesson plan is to
1. ensure that the subject matter will be covered
2. set forth the objectives of the lesson
3. summarize the major points of the lesson
4. ensure that the subject matter, even if taught by different instructors, will be presented in the same manner to each class

4-47. Which of the following statements is LEAST descriptive of informal training?
1. It is on-the-job training
2. It does not require special training equipment
3. It is easier to work into the daily work schedule than formal training
4. It is performed under the direct supervision of the work center supervisor

4-48. What type of learning is received through Rate Training Manuals?
1. Knowledge requirements
2. On-the-job training
3. Maintenance requirements
4. All of the above

4-49. Who is responsible for conducting on-the-job training within the work center?
1. Department Chief Petty Officer
2. Division Chief Petty Officer
3. Training Petty Officer
4. Work Center Supervisor

4-50. Which of the following maintenance training commands are of interest to the Aviation Support Equipment Technician?
1. NATTC, Memphis
2. NAMTRAGRU, JAX
3. All Naval Air Rework Facilities
4. Both 1 and 2 above

4-51. Which of the following schools provide specialized training on GTCP-100 gas turbine engines?
1. "A" schools
2. "B" schools
3. "C" schools
4. "F" schools

4-52. Assistance to intermediate maintenance activities in training AS personnel on selected GSE is provided by the
1. Chief of Naval Operations
2. Naval Air Systems Command
3. Naval Air Maintenance Training Group
4. Naval Air Technical Services Facility

4-53. The responsibility to provide GSE licensing materials to individual commands rests with
1. NAVAIR
2. AIRLANT/PAC
3. NAMTRAGRU
4. NATTC

4-54. If training material and license performance standards on new or additional GSE is received from NAMTRAGRU, what is the maximum length of time that may elapse before local maintenance personnel must be licensed under the approved standards?
1. 30 days
2. 60 days
3. 90 days
4. 120 days

4-55. The GSE operator's license is valid for a period of
1. 4 years
2. 3 years
3. 2 years
4. 1 year

4-56. A GSE operator's license covering several pieces of equipment
1. must be renewed by the latest expiration date noted in the expiration date column
2. must be renewed by the earliest expiration date noted in the expiration date column
3. must be renewed if 3 years have elapsed since the operator reported to the support equipment work center
4. need not be renewed as long as the operator remains in the support equipment work center

4-57. What must you have in order to operate self-propelled automotive type equipment?
1. GSE operator's license
2. Government motor vehicle operator's card
3. Military identification card
4. Both 1 and 2 above

4-58. After an AS attached to an organizational maintenance activity has satisfactorily completed the necessary training, a GSE operator's license may be issued to him by the
1. Chief of Naval Operations
2. Naval Air Maintenance Training Group
3. intermediate maintenance activity providing the training
4. organizational maintenance activity to which he is attached

4-59. When there is sufficient reason for revoking a GSE operator's license, the license is revoked by the
1. commanding officer or officer-in-charge
2. activity providing the GSE training course qualifying the operator for the license
3. work center supervisor
4. maintenance officer

4-60. The information sheet, general military training syllabus, professional training syllabus, and information/on-the-job training record or PQS Qualification card are all on the right-hand side of the training folder.

Assignment 5

GSE

Text: Pages 5-7 through 6-25

Learning Objective: Recognize capabilities and operating characteristics of ground support equipment, including applicable maintenance procedures.

5-1. Ground Support Equipment (GSE) is used in support of naval aircraft in many ways including handling, servicing, loading, and testing. The principal users are
1. aircraft squadron personnel
2. aircraft carrier personnel
3. crash and fire personnel
4. all of the above

5-2. AS personnel are primarily concerned with which of the following in regards to GSE?
1. Operation and servicing
2. Major inspections and repair
3. Preoperational inspection
4. Repair only

5-3. Within the scope of his rating, the AS is also responsible for
1. effectively performing all phases of maintenance
2. training squadron personnel in the servicing and operation of GSE
3. testing and licensing of an operator of GSE that requires a license
4. all of the above

5-4. Which of the following types of GSE is it an AS's responsiblity to maintain?
1. Avionic
2. Nonavionic
3. Ordnance equipment
4. Peculiar avionic

Learning Objective: Indicate the proper operating characteristics and procedures for the aircraft tow tractor.

5-5. The maneuverability required in a tow tractor used in moving aircraft and/or trailer-mounted support equipment is dependent upon the
1. tractor's transmission
2. tractor's dimensions and turning radius
3. size and weight of the tractor
4. size and weight of the aircraft and/or equipment to be moved

5-6. To allow for the smoothest and safest movement of aircraft and equiment, and to allow the driver to be able to concentrate on the job at hand, the tow tractor is equipped with which, if any, of the following?
1. A standard transmission
2. An automatic transmission
3. Power steering and standard transmission
4. None of the above

5-7. The term drawbar pull refers to the
1. traction provided by a surface on which tractors operate
2. type of transmission between a tractor's engine and its wheels
3. pulling force of which a tractor is capable
4. maximum load to which a drawbar may be attached

5-8. The series into which tow tractors are usually classified are
1. M and TA
2. M and TD
3. T and MD
4. T and MA

5-9. After the MD-3 tow tractor has had its first modification it is designated an
1. MDA-3
2. MD-3-1
3. MD-3B
4. MD-3A

In items 5-10 through 5-13, select from column B a characteristic of each tow tractor listed in column A.

	A. Tractors		B. Characteristics
5-10.	MD-3	1.	It has an 18,000-lb drawbar pull
5-11.	TA-18	2.	It weighs 47,000 lb
5-12.	TA-75	3.	It is designed for towing and spotting aircraft on shore stations
5-13.	MRS-190	4.	It is designed to tow all carrier aircraft aboard a carrier

---

5-14. Which of the following statements relative to the MD-3 tow tractor is false?
1. The tractor is capable of 8,500-pound drawbar pull at approximately 10 mph on dry or wet concrete surfaces
2. The tractor is powered by a four-stroke cycle, internal combustion engine
3. The gas turbine compressor mounted on the rear of the tractor provides compressed air for pneumatic equipment
4. The multiple drive reduction gear shifts automatically in all forward gear ratios

5-15. You must be familiar with the instruments and controls of a tow tractor because you are required to operate them when
1. training other personnel
2. testing after repairs have been made
3. troubleshooting
4. doing all of the above

5-16. Normal starting procedures for the MD-3 tractor should not be followed if the average ambient temperature drops below
1. 10° F
2. 21° F
3. 30° F
4. 41° F

5-17. If the MD-3 engine fails to start when following normal starting procedures, before attempting another start you should wait
1. 30 seconds
2. 45 seconds
3. 60 seconds
4. 2 minutes

5-18. After the MD-3 tractor's engine is started, what action should you take if there is a sudden excessive rise in engine temperature?
1. Stop the engine
2. Check the operation of the ammeter
3. Check the water temperature
4. Check the operation of the glow plugs

5-19. Which action should you NOT take during cold weather starting?
1. Pressing the glow plug switch to preheat the combustion chambers
2. Releasing the glow plug switch prior to pressing the starter switch
3. Allowing the combustion chambers to preheat in accordance with the preheating chart for the ambient air temperature
4. Continuing to depress the glow plug switch while pressing the starter switch until the engine fires regularly

5-20. How long should the tractor's engine be allowed to idle?
1. Until the oil pressure gage indicates oil circulation
2. Until the engine temperature gage indicates the engine is warm
3. Until the air pressure gage indicates full air pressure is developed and the air low-pressure warning light is off
4. Until all of the above indications are obtained

5-21. In which position should the tractor's transmission lever be placed for moving light and moderate loads forward?
1. R
2. L
3. D
4. Any of the above

5-22. If the accelerator of the tractor at a standstill is fully depressed with the transmission lever in D, the transmission will
1. remain in second gear
2. downshift to first gear
3. shift from second to third gear
4. slip until the operator manually places the lever in L

Learning Objective: Identify characteristics of the SD-1D spotting dolly and the means of controlling movement.

5-23. Movement of aircraft where very little maneuvering room is available can be accomplished best by means of a
1. tow bar and tractor
2. mobile crane
3. spotting dolly
4. tow bar and manpower

5-24. The SD-1D spotting dolly can rotate with zero turning radius about an axis located
1. midway between the two drive wheels
2. at the axle of the free-wheeling caster
3. midway on the fore-and-aft centerline of the dolly
4. at the axle of either drive wheel, depending upon which way the dolly is turning

5-25. What must you do to the handle on the end of the control arm of the SD-1D dolly in order to control the forward and backward movement of the dolly?
1. Push it to the right or to the left
2. Push it forward or pull it backward
3. Depress it or raise it
4. Twist it

5-26. The maximum speed for towing an aircraft with a spotting dolly is
1. 1 mph
2. 2 mph
3. 5 mph
4. 10 mph

Learning Objective: Recognize characteristics and functions of mobile cranes.

5-27. Mobile cranes were designed primarily for salvage and rescue operations both aboard ship and at shore stations.

5-28. Maximum performance of a crane is directly dependent upon
1. the frequency and scope of its preoperational checks
2. the frequency and scope of its maintenance
3. the ability of its operator
4. both 2 and 3 above

5-29. Direct current (d.c.) is used by the NS-60 crane for powering
1. its hook
2. its wheels
3. its boom
4. both 1 and 2 above

5-30. When hoisting an aircraft, if the NS-60 crane's a.c. generator fails, the crane will
1. drop the aircraft
2. lower the aircraft slowly
3. hold the aircraft stationary
4. continue hoisting the aircraft

5-31. The MB-1A mobile crane is a diesel engine-powered 4-wheeled vehicle designed for the primary function of lifting and removing crashed aircraft from a carrier's flight deck.

5-32. Which of the following, acting together, furnish power to the steering motor of the MB-1A crane?
1. Diesel engine and an a.c. generator
2. Diesel engine, five-speed transmission, and an a.c. generator
3. Diesel engine, five-speed transmission, auxiliary transmission, and an a.c. generator
4. Diesel engine, five-speed transmission, auxiliary transmission, torque proportioning differential, and an a.c. generator

5-33. The brakes on the MB-1A mobile crane are applied by
1. hydraulic pressure
2. air pressure
3. air and hydraulic pressure
4. electrically actuated hydraulic pressure

Learning Objective: Recognize characteristics of mobile electrical powerplants (MEPPs) and their uses.

5-34. Mobile Electric Power Plants (MEPPs), used to supply a.c./d.c. electrical power to modern jet aircraft are designated by the letter prefix
1. NR
2. NA
3. NB
4. NC

5-35. Which electrical power unit is designed for starting aircraft aboard a carrier in case the deckedge power is disrupted?
1. NC-2A
2. NC-5
3. NC-10
4. NC-12

5-36. The front axle, 28 V d.c. motor is capable of driving the NC-2A up to a maximum speed of
1. 5 mph
2. 10 mph
3. 14 mph
4. 24 mph

5-37. The NC-2A is powered by a/an
1. gasoline engine
2. electric motor
3. diesel engine
4. hydraulic pump

5-38. What does the NC-8A furnish to an aircraft for power?
1. 90 kva, 120/208 V a.c., 3 phase, 400 Hz
2. 60 kva, 120/208 V a.c., 3 phase, 400 Hz
3. 30 kva, 110/200 V a.c., 3 phase, 200 Hz
4. 30 kva, 110/200 V a.c., 2 phase, 400 Hz

5-39. How many cylinders does the NC-8A diesel engine have?
1. Six
2. Two
3. Three
4. Four

5-40. The power supply/transformer rectifier (T/R unit) provides d.c. power to aircraft with electric starters and is an add-on to the
1. NC-2A
2. NC-8A
3. NC-4B
4. NC-1A

5-41. Which of the following electrical power units are self-propelled?
1. NC-2A and NC-8A
2. NC-2A, NC-8A, and NC-10B
3. NC-8A and NC-10B
4. NC-10B only

5-42. Mobile Motor-Generator sets (MMGs) are self-contained, sled-mounted power units designed primarily for use on shore stations to supply 220-440 V a.c./60 Hz to large naval aircraft.

5-43. The Flight Line Electrical Distribution System (FLEDS) is designed to service aircraft on the flight line with
1. 110/200 volts, 3-phase, 400 Hz power
2. 115/220 volts, 3-phase, 400 Hz power
3. 115/200 volts, 2-phase, 400 Hz power
4. 115/200 volts, 3-phase, 60 Hz power

Learning Objective: Recognize characteristics and capabilities of forklifts, preheaters, and different types of mobile air conditioners.

5-44. Of all the various types of forklift trucks which the AS may be required to work on, the one most often encountered is powered by a
1. gas turbine engine
2. d.c. electric motor
3. gasoline engine or diesel engine
4. diesel/electric engine

5-45. What restrictions, if any, are there with reference to personnel operating forklifts?
1. The operator must have 20/20 vision (corrected)
2. The operator must be a rated person
3. The operator must be licensed
4. None; anyone may operate the forklift

5-46. The two-cylinder, air-cooled engine of the MPH-3 portable preheater drives the
1. vehicle
2. generator only
3. ventilating air blower only
4. generator and air blower

5-47. A ground support equipment air-conditioning unit is usually trailer-mounted, driven by a gasoline, diesel engine or electric motor and designed to provide ground ventilating and cooling for aircraft cabins and electronic systems.

5-48. Air-conditioning units are identified by which letter designation?
1. NC
2. AC
3. NR
4. NB

5-49. An NR-5C air conditioner is used to cool an aircraft's
1. engine
2. exhaust gases
3. cabin
4. generator

5-50. The NR-5C is powered by a/an
1. diesel engine
2. electric motor
3. gasoline engine
4. set of batteries

5-51. The NR-10 mobile air conditioner is powered by which of the following?
1. A 30 horse-power electric motor
2. An 82 horse-power diesel engine
3. An 82 horse-power gasoline engine
4. Any one of the above

Learning Objective: Relative to gas turbine compressor units (GTC), recognize capabilities, similarities, and differences as related to purpose, general operating characteristics, functions of major components, and associated hazards.

5-52. Gas turbine power units are driven by
1. diesel engines
2. gas engines
3. electric motors
4. gas turbine engines

5-53. What do the gas turbine units used in ground support equipment supply?
1. Air for aircraft starters
2. Refrigeration for aircraft cabins
3. Power drive for tow tractors
4. Refrigeration for pilot comfort

5-54. As an AS, what is your major responsibility concerning gas turbine power equipment?
1. Inspection, maintenance, and repair
2. Issue, cleaning, and inspection
3. Servicing, inspection, and repair
4. All of the above

5-55. The GTC-85 gas turbine engine has which of the following types of compressors?
1. Single-stage axial
2. Two-stage axial
3. Single-stage centrifugal
4. Two-stage centrifugal

5-56. The GTC-85 compressor supplies which of the following ratio(s) of compressed air for aircraft starting?
1. 5.3:1 and 5:1
2. 5:1
3. 3.6:1
4. 3.6:1 and 5.3:1

5-57. Some GTC-85 enclosures are mounted on trailers, while others are mounted on which of the following tractors?
1. MD-3A only
2. MD-3B only
3. MD-3A and MD-3B

5-58. What are the two pressures of compressed air supplied by the NCPP-105?
1. 5:2 and 3:0
2. 5:1 and 3.6:1
3. 5:1 and 3.6:3
4. 5:1 and 5.6:3

5-59. The NCPP-105 gas turbine enclosure has the GTC-85-72 engine installed and is unique in that it may be operated satisfactorily while hung as an external store on an airborne aircraft.

Learning Objective: Recognize the Aero 47A weapons loader, P-36 airfield maintenance and the MB-5 aircraft firefighting and rescue truck and the truck's operational features.

5-60. How is the lifting function of the Aero 47A weapons loader powered?
1. Electrically
2. Hydraulically
3. Electrohydraulically
4. By any of the above means, depending upon the mode of operation selected

5-61. Which of the following is NOT a feature of the Aero 47A weapons loader?
1. Turning radius of 15 ft
2. Carrying capacity of 6,500 lb
3. Powered by a 27.5 horsepower multifuel burning engine
4. Prepackaged multiple suspension rack loading capability

5-62. If mechanical or hydraulic failure of the Aero 47A weapon loader occurs, the load will
1. slowly lower to the at-rest position
2. rise to the highest position
3. set the parking brake
4. remain stationary

5-63. Which of the following statements about the P-36 airfield maintenance truck is INCORRECT?
1. It has a coil and distributor type of ignition system
2. Its air-cooled, 34-horsepower engine has four cylinders
3. Both its transmission and steering are manually operated
4. It has pneumatically-operated shoes located in the front wheel brake drums

5-64. The P-36 airfield maintenance truck is better suited for use on paved surfaces than on nonpaved surfaces because of its

1. air-cooled engine
2. open operator's compartment
3. five-inch clearance
4. 34-horsepower engine

5-65. The MB-5 aircraft firefighting and rescue truck was designed primarily for use aboard aircraft carriers.

5-66. Who has the responsibility to maintain the truck on shore stations?

1. The AM personnel
2. The AS personnel
3. The Public Works Department personnel
4. The applicable intermediate maintenance activity personnel

5-67. The MB-5 is powered by a turbo-charged diesel engine with

1. four cylinders
2. six cylinders
3. eight cylinders
4. three cylinders

5-68. What decreases the warmup time and maintains the proper operating temperature of the MB-5 engine?

1. The regulator valve in the water jacket
2. The thermostatically-controlled radiator shutters
3. Both 1 and 2 above

5-69. The MB-5 has a semiautomatic transmission that provides (a) how many speeds forward and (b) how many speeds in reverse?

1. (a) 4 (b) 2
2. (a) 3 (b) 1
3. (a) 4 (b) 1
4. (a) 4 (b) 4

5-70. In which gear will the truck's semiautomatic transmission upshift and downshift with the corresponding increase and decrease of engine speed?

1. Fourth
2. Third
3. Second
4. First

5-71. When operating the truck in a low gear under a heavy pulling condition, the transmission should be shifted to the next higher gear when the tachometer indicates

1. 2,200 rpm
2. 1,850 rpm
3. 1,500 rpm
4. 1,200 rpm

5-72. The engine-driven air compressor provides air pressure for operating

1. the hydraulic brake system power unit
2. the various control units
3. the windshield wipers
4. all of the above

5-73. The auxiliary power generator is used only for supplying current to operate the hand power tools and accessories.

5-74. How many ways can the auxiliary generator be started?

1. One
2. Two
3. Three
4. Four

Assignment 6

Ground Support Equipment

Text: Pages 6-25 through 6-57

Learning Objective: Recognize shipboard firefighting equipment and the procedures for its use and operation.

6-1. The TAU-2 firefighting unit is a self-contained unit designed for
1. shipboard use only
2. shore stations only
3. shipboard or shore stations

6-2. The TAU-2 firefighting unit may be mounted on which of the following types of GSE for use on the flight deck?
1. Aero 21C only
2. MD-3 only
3. Both 1 and 2 above

6-3. The TAU-2 has two tanks installed which contain solutions consisting of materials commonly referred to as
1. PKP
2. light water
3. nitrogen
4. both 1 and 2 above

6-4. For the proper operation of the TAU-2 unit, the 400 cubic-foot capacity nitrogen cylinder must have a charge of which of the following ranges of pressure at 70° Fahrenheit?
1. 1600 to 2300 psi
2. 1800 to 2400 psi
3. 1700 to 2400 psi
4. 1900 to 2300 psi

6-5. The A/S 32 P-16 firefighting truck (type TAU-3) is designed for shipboard flightdeck use because of which of the following characteristics?
1. Low profile and size
2. Maneuverability
3. Self-propelled
4. All of the above

6-6. The A/S 32 P16 firefighting truck (commonly called P-16) is powered by a
1. four cylinder diesel engine
2. four cylinder gasoline engine
3. three cylinder diesel engine
4. three cylinder gasoline engine

6-7. The drive system of the P-16 utilizes a hydrostatic transmission which allows the engine to operate at governed speed and permits operation of which of the following at all times?
1. Hydraulic pump
2. Light water pump
3. Either 1 or 2 above
4. Differential unit

6-8. When the neutral safety switch (interlock button) is pushed in, the transmission selector lever located in the driver's compartment is used for
1. neutral only
2. forward and reverse only
3. forward, neutral, and reverse
4. none of the above; it disengages the engine to allow for starting

6-9. The speed control foot pedal located in the driver's compartment is used to regulate which of the following?
1. Engine
2. Drive pump
3. Light water pump
4. All of the above

6-10. The electrical system of the P-16 is
1. 24 volts d.c.
2. 24 volts a.c.
3. 12 volts d.c.
4. 28 volts a.c.

6-11. The service brakes are internal expanding drum-type located on all four wheels and are actuated by
1. hydraulic pressure
2. air pressure
3. mechanical linkage
4. combination of all the above

Learning Objective: With regard to hydraulic component test stands, recognize types, uses, and operational characteristics and procedures.

6-12. AHT-63/64 portable hydraulic test stands are connected to an aircraft's hydraulic system by
1. quick disconnects
2. plug-ins
3. bayonet fittings
4. B-4 nuts

6-13. What type of pump does the AHT-63 hydraulic unit have?
1. Rotary piston
2. Axial piston
3. Gear rotary
4. Axial gear

6-14. The AHT-63 test stand is capable of circulating 13 gallons of hydraulic fluid per minute through the system at a pressure of
1. 1,000 psi
2. 3,000 psi
3. 3,500 psi
4. 5,000 psi

6-15. All portable hydraulic test stands must be equipped with a 3-micron or smaller nonbypass type filter before being used on any naval aircraft hydraulic system.

6-16. The Model H-250-1 hydraulic fluid servicing unit is operated with a hand pump and has a fluid capacity of
1. one gallon
2. two gallons
3. three gallons
4. four gallons

6-17. The H-250-1 servicing unit is equipped with a top piercing pin which is drilled to provide for
1. fluid by-pass only
2. piercing the fluid container only
3. a check valve
4. atmospheric venting

6-18. The Model HSU-1 hydraulic servicing unit has a fluid capacity of
1. one gallon
2. two gallons
3. three gallons
4. four gallons

6-19. The HSU-1 is equipped with a reservoir sight gage that reads from
1. 0 to 2 gallons
2. 0 to 3 gallons
3. ¼ to 2 gallons
4. ½ to 3 gallons

6-20. The H-250-1, HSU-1, and Model 310 hydraulic servicing units are similar in that they are all operated by hand and deliver 3-micron (absolute) filtered fluid, but they do have different fluid capacities.

Learning Objective: Identify the steam cleaner and dry honing machine and describe their characteristics.

6-21. What fuel is used in steam cleaners to heat the cleaning compound?
1. Kerosene
2. Diesel fuel
3. Aircraft gasoline
4. Automotive gasoline

6-22. The portable dry honing machine is primarily used with
1. ground support equipment
2. aircraft and aircraft components
3. hoisting slings
4. ordnance support equipment

6-23. Which of the following abrasives are used in the portable dry honing machine?
1. Glass beads
2. Aluminum oxide particles
3. Abrasive debris
4. Either 1 or 2 above

6-24. What type of abrasive should be used in the dry honer on metal that will corrosively react with aluminum?
1. Soft grit
2. Glass beads
3. Aluminum oxide
4. Sand

6-25. Before starting the dry honing process on a piece of equipment, you must remove which of the following from the surface?
1. Oil
2. Water
3. Debris
4. All of the above

6-26. What must be done when working with the dry honer to prevent the loss of abrasives?

1. The blast control valve must be released before the gun is raised from the surface
2. The blast control valve must be released before the gun is pressed to the surface
3. The blast control valve must be released at all times
4. The blast control valve must be closed at all times

Learning Objective: Identify a characteristic of the preservation/depreservation trailer and uses of the aircraft crash dolly.

6-27. Trailers have at least two of their wheels equipped with a brake system.

6-28. The unpowered truck dolly is commonly referred to as a/an

1. tractor dolly
2. crash dolly
3. vehicle dolly
4. aircraft dolly

6-29. An aircraft crash dolly may be used to support only a part of an aircraft's weight.

6-30. In describing the preservation/depreservation trailer, which of the following statements is true?

1. The trailer's head pressure can be varied between 220 and 440 psi
2. The trailer is designed to be transported only by towing
3. The trailer is equipped with a 20-gallon preservation fluid tank and a 30-gallon depreservation tank
4. The trailer's electrically-driven pump can supply preservation fluid at the rate of 3 gallons per minute

Learning Objective: With regard to liquid and gaseous nitrogen, identify associated characteristics, classifications, handling procedures, and uses.

6-31. The use of nitrogen is preferred over the use of compressed air in many aircraft and missile pneumatic systems because nitrogen

1. cannot support living organisms
2. cannot support combustion and fire
3. does not cause rust or decay of the surfaces with which it comes in contact
4. possesses all of the above characteristics

6-32. The difference between class I and class II nitrogen is that class I is

1. oil-pumped and class II is water-pumped
2. water-pumped and class II is oil-pumped
3. compressed by a lubricated pump and class II is compressed by a nonlubricated pump
4. available in military supply and class II is not

6-33. Class II nitrogen must never be used to purge an oxygen system because, even though nitrogen is inert, the oil in it can explode in the presence of oxygen.

6-34. Why does liquid nitrogen that is stored or used in an inadequately ventilated place create a hazardous condition?

1. Because it expands and lowers the oxygen content of the air which can cause dizziness, unconsciousness, and even death
2. Because it is toxic and can cause nausea, vomiting, and even death
3. Because it is very flammable and explosive
4. Because of all of the above

6-35. Inasmuch as liquid nitrogen is much colder than liquid oxygen, if liquid nitrogen is exposed to air for any length of time oxygen from the air may condense into the nitrogen.

6-36. If you grasp a line containing liquid nitrogen and are not wearing protective hand coverings, your hands may be injured because they will stick to the line.

Learning Objective: Identify capacities, design features, component functions, operating procedures, and related safety precautions concerning liquid oxygen.

6-37. There are two types of aviator's breathing oxygen supplied for use in the Navy, type I and type II. In what forms are these two types?
1. Type I is gaseous; type II is liquid
2. Type I is liquid; type II is gaseous
3. Type I is liquid; type II is liquid
4. Type I is gaseous; type II is gaseous

6-38. Liquid oxygen (commonly referred to as LOX) is normally obtained by a combined cooling and pressurization process. Once converted to a liquid, it will remain a liquid if the temperature is maintained below
1. -182° F
2. -182° C
3. -297° C
4. -297° F

6-39. Liquid oxygen trapped in a line between closed valves may create a hazardous condition unless some type of relief device is functionally associated with the line.

6-40. Control of contamination requires that you exercise extreme care in handling liquid oxygen because oxygen readily absorbs nearly all forms of contamination.

6-41. The desirable goals for liquid oxygen contamination control are best described by the phrase
1. clean and dry
2. clean and odor-free
3. clean and oil-free
4. clean and protected from the atmosphere

Learning Objective: Recognize procedures and equipment involved in the operation, testing, troubleshooting, and maintenance of the No. 4 Ronan and Kunzel liquid oxygen servicing trailer.

6-42. The No. 4 LOX servicing trailer has a capacity of
1. 30 gallons
2. 50 gallons
3. 60 gallons
4. 90 gallons

6-43. The No. 4 LOX trailer is equipped with all the necessary control valves, gages, pressure relief valves, and blowout rupture discs for simple and safe operation. They are located in which of the following places?
1. Tank front
2. Tank rear
3. Tank sides
4. Trailer frame

6-44. The vent line and fill-drain line connect the
1. inner tank to the internal piping
2. outer tank to the external piping
3. outer tank to the internal piping
4. inner tank to the external piping

6-45. The component that operates as a heat exchanger to vaporize liquid oxygen and pressurize the inner tank during transfer of LOX is called the
1. pressure buildup coil
2. pressure relief coil
3. vacuum relief coil
4. pressure vaporizer

6-46. In the event that the inner tank is damaged, what component is designed to release the pressure between the inner and outer tank?
1. Pressure relief valve
2. Safety rupture disc
3. Safety vent line
4. Pressure vent valve

6-47. A direct reading pressure gage is provided on the control hood to indicate which of the following conditions in the inner tank?
1. Liquid level
2. Vacuum
3. Pressure in the tank
4. All of the above

6-48. Pull-to-test handles are located on the hood of LOX servicing trailers for which of the following pressure relief valves?
1. Tank
2. Hose
3. Both 1 and 2 above
4. Converter

Refer to figure 6-36 in your textbook. In questions 6-49 through 6-52, select the proper color code from column (B) for the control valves listed in column (A).

	A. Control Valve	B. Color Code
6-49.	Fill-drain valve	1. Yellow
6-50.	Capacity gage valve	2. Black
6-51.	Vacuum valve	3. Blue
6-52.	Vent valve	4. Red

6-53. On the No. 4 LOX trailer, which component causes the liquid to evaporate?
1. The vent line
2. The surge tank
3. The vacuum line
4. The pressure buildup coil

6-54. Assume that after a transfer has been completed, the trailer contains 30 gallons of LOX. If no further transfer is to be made within 4 hours, which valve(s) must be left open?
1. The vent line
2. The tank pressure-relief valve
3. Both 1 and 2 above
4. The vacuum valve

6-55. Which of the following control valve(s) is/are used only when pumping down the vacuum space between the tanks?
1. Vent and vacuum
2. Fill-drain and vent
3. Vent
4. Vacuum

Learning Objective: Recognize operational features and component functions of the TMU 70/M liquid oxygen servicing trailer and indicate related operating, inspection, and troubleshooting procedures.

6-56. The low loss, closed loop system reduces the loss of liquid oxygen during transfer and eliminates the safety hazards associated with venting oxygen in critical areas.

6-57. The transfer tank uses cold gas pressure from the pressure buildup unit to transfer liquid oxygen to the aircraft converter.

6-58. Which of the following statements regarding the transfer lines and piping system is FALSE?
1. The pressure relief valve system, which is part of the piping system, is connected to the vent system
2. The transfer lines carry liquid oxygen from the transfer tank to the aircraft converter and then to the storage tank
3. The lines are kept to a minimum length to reduce cooldown and heat losses
4. The closed loop of the transfer lines

6-59. Which of the following statements concerning the indicating gages of the TMU 70/M servicing trailer is NOT correct?
1. The storage tank liquid level gage is calibrated in gallons
2. The transfer tank liquid level gage is calibrated in percent full
3. The storage tank pressure gage should indicate a higher pressure than the transfer tank pressure gage while servicing a converter
4. The converter full indicator monitors the converter vent line temperature and indicates GAS during transfer to the converter and LIQUID when the converter is full

6-60. Under which of the following conditions should the vent line shutoff valve on the storage tank be in the closed position?
1. When the storage tank is being filled
2. When the unit is in idle storage
3. When the unit is being used in flight line servicing
4. Under the conditions specified in both 1 and 3 above

6-61. Under normal conditions and with 30 psig of transfer pressure, the storage tank should be filled within a period of
1. 5 to 10 minutes
2. 5 to 8 minutes
3. 4 to 8 minutes
4. 3 to 6 minutes

Learning Objective: Recognize operational characteristics and procedures, maintenance practices, and functions of gaseous oxygen servicing trailer components.

6-62. The shutoff valves control the flow of oxygen from the
1. upper manifold to the lower manifold, directly
2. lower manifold to the upper manifold, directly
3. upper manifold to the lower manifold, via the regulator
4. lower manifold to the upper manifold, via the regulator

6-63. When an oxygen system is serviced with the trailer, the flow of oxygen is controlled by
1. line servicing valve
2. pressure regulator
3. manifold valve
4. recharge valve

6-64. What is the correct sequence of oxygen flow from the cylinders through the trailer to the aircraft oxygen system?
1. Cylinders--pressure regulator--drier--manifold control valve--lower manifold--upper manifold--aircraft
2. Cylinders--manifold control valve--upper manifold--pressure regulator--lower manifold--drier--aircraft
3. Cylinders--upper manifold--manifold control valve--lower manifold--drier--pressure regulator--aircraft
4. Cylinders--drier--manifold control valve--upper manifold--lower manifold--pressure regulator--aircraft

---

Learning Objective: Recognize the operational characteristics of aircraft jacks, workstands, aircraft tow bars, and tiedown chains; recognize safety hazards related to the use of ground support equipment and the procedures to follow when a safety hazard is discovered.

6-65. Ground support equipment jacks must never be used to lift an aircraft.

6-66. Which of the following types of jacks should you use to raise the complete aircraft?
1. Alligator axle
2. Handle axle
3. Tripod
4. Crocodile axle

6-67. Which of the following NAVAIR publications lists all jacks, their identification number, and the jacking point at which location the jack can be used on the aircraft?
1. NAVAIR 19-70-52
2. NAVAIR 19-70-46
3. NAVAIR 19-70-48
4. All of the above

6-68. All adjustable aircraft maintenance platforms (workstands) are stationary and are operated by hydraulics or pneumatics with a maximum working height of six feet.

6-69. The aircraft tow bar that is used on most naval aircraft is model number
1. TD-1A
2. NT-4
3. NT-1
4. SD-1D

6-70. The tubing of the NT-4 universal aircraft tow bar is manufactured from which of the following alloys?
1. Steel
2. Aluminum
3. Monel-metal
4. All of the above

6-71. A universal wheel chock may be used with any aircraft's main landing gear providing the wheel diameter is not more than
1. 28 inches
2. 38 inches
3. 45 inches
4. 90 inches

6-72. What is the most common type of tiedown used for securing parked aircraft and ground support equipment?
1. Hurricane tiedown
2. TD-1A
3. TD-4
4. Wire rope

6-73. What is the rated working capacity of the TD-1A tiedown chain?
1. 6,000 lb
2. 10,000 lb
3. 12,000 lb
4. 16,000 lb

6-74. When work is in progress on and around ground support equipment, to what is safety directly related?
1. Cooperation between people who use and maintain support equipment
2. Constant vigilance
3. Common sense
4. All of the above

6-75. If you see a safety hazard in your shop, what should you do?
1. Report the fact to your supervisor
2. Warn other workers of the danger
3. Exercise as much caution as possible under existing conditions
4. All of the above

Assignment 7

Tools and Test Equipment

Text: Pages 6-57 through 7-44

Learning Objective: Recognize proper procedures for the issue and turn-in of tools, and the importance of tool inventory.

7-1. In handling tools, what do you, as an AS, practice if you have careful, safe, and clean work habits?
1. Account for all of your tools each time a job is completed
2. Use your tools for the purposes intended
3. Maintain your tools in good repair
4. All of the above

7-2. Information on common handtools can be found in which manual(s)?
1. Airman, NAVPERS 10307, Chapter 10
2. NAVEDTRA 10314-B
3. NAVPERS 10085, Chapter 2
4. Both 1 and 3 above

7-3. Ensuring all tools are properly marked as to organization, work center and toolbox, and that all toolboxes are properly numbered is the responsibility of the
1. shop chief
2. toolroom personnel
3. work center supervisor
4. division chief

7-4. Upon completion of a job, what main purpose is served by the reinventory of tools taken to the job?
1. It aids in keeping track of tools issued
2. It is a check for tools against the toolroom allowance
3. It is a check for tools left within or around the equipment
4. It provides a check of tools that are on temporary custody

Learning Objective: Identify various types of handtools, their operating and design characteristics, and their proper uses and care.

7-5. For which of the following operations are diagonal pliers best suited?
1. Grasping cylindrical objects
2. Cutting objects flush with the surface
3. Bending heavy gage material
4. Straightening bent cotter pins

7-6. What advantage does a 6-point socket have over a 12-point socket?
1. It has a 6-point drive
2. Each of its flats allows a 30-degree turning movement
3. It is not subject to as much wear when used on stainless steel nuts
4. It needs to swing only half as much before it is lifted and fitted for a new grip

7-7. The size of 6-point and 12-point socket openings are graduated in increments of
1. 1/16 in
2. 1/8 in
3. 1/4 in
4. 3/8 in

7-8. Which handle has a built-in reversible feature?
1. Speed
2. Ratchet
3. Sliding T-bar
4. Hinged

7-9. In order to remove a nut in a hurry using a speed handle, the nut should first be loosened by using
1. a ratchet handle
2. a ratchet handle and a sliding T-bar handle
3. a ringed handle
4. all of the above

7-10. Which of the socket wrench accessories illustrated in figure 7-3 of your textbook should you use to turn a 1/4-inch square drive socket with a 3/8-inch square drive handle?
1. Adapter
2. Extension bar
3. Universal joint
4. Universal socket

7-11. The box-end portion of a combination wrench is off-set how many degrees?
1. 10
2. 15
3. 20
4. 25

7-12. When a nut is turned with an adjustable wrench, which of the following procedures should NOT be used?
1. Setting the jaw to grip the nut firmly
2. Gripping the nut in the throat of the jaw
3. Drawing the handle toward the adjustable jaw
4. Using a pipe extension for more leverage

7-13. A damaged common screwdriver may be repaired by the use of a/an
1. file
2. emery wheel
3. whetstone
4. oilstone

7-14. Using a Reed and Prince or Phillips screwdriver on the wrong type of screw will damage the
1. work
2. screwhead
3. screwdriver
4. worker

In items 7-15 through 7-18, select from column B the pliers needed to perform the tasks listed in column A.

A. Tasks

7-15. Clamping and locking in position by pulling the lever toward the handle

7-16. Pulling or working within confined area where fingers cannot reach

7-17. Grasping cylindrical objects

7-18. Cutting wire and grasping small objects

B. Pliers

1. Duckbill
2. Needle-nose
3. Channel lock
4. Vise grip

7-19. What tool is designed to retrieve small objects from places that are inaccessible by hand?
1. Mechanical fingers
2. Needle-nose pliers
3. Slip-joint pliers
4. Duckbill pliers

7-20. The correct way to measure with a steel scale is to take the reading with the scale sitting on its edge.

7-21. Nonmagnetic tools require special handling in their use because they
1. are harder than steel tools
2. may become magnetized
3. can damage components such as magnets
4. are not as rugged as steel tools

7-22. When is the use of insulated tools mandatory?
1. When the equipment is too warm to touch by hand
2. When there is danger of electrical shock
3. When the use of the tool may cause a short circuit
4. When either 2 or 3 above is possible

7-23. Which of the following items should be used to clean dirty relay contact points?
1. Sandpaper
2. Emery cloth
3. A burnishing tool
4. Either 1 or 2 above

7-24. What tool should be used to align relay contacts?
1. Point bender
2. Burnishing tool
3. Relay compressor
4. Brush spring compressor

7-25. What will be the effect on a stranded wire that is to be stripped if the wire is placed into a groove that is too small?
1. The wire will be stretched
2. The insulation will not be completely severed
3. Some of the wire strands will be severed
4. The wire will be properly stripped because the stripper automatically adjusts to the proper size

7-26. Refer to figure 7-16. Where does the type MS 25037-1 crimping tool crimp the terminal lug?
1. Around the bare wire
2. Around the insulation
3. Around both the bare wire and the insulation
4. On the surface which extends beyond the guard

7-27. For a bolt to hold tight enough and NOT break when pressure is exerted against it, it must be properly tightened by a
1. socket wrench
2. box-end wrench
3. torque wrench
4. open-end wrench

7-28. Which type of torque wrench can be preset to the desired torque?
1. Deflecting beam
2. Micrometer setting
3. Rigid frame
4. Dial indicating

7-29. How often should a torque wrench be tested?
1. Every 15 days
2. Every 25 days
3. Every 30 days
4. Every 60 days

7-30. To determine the proper torque to apply to a fastener, to what publication should you refer?
1. The maintenance manual for the equipment
2. The torque value conversion table
3. The torque wrench calibration instruction
4. The torque wrench accuracy range table

7-31. How many types of micrometers are commonly used throughout the Navy?
1. 5
2. 2
3. 3
4. 4

In items 7-32 through 7-35, select from column B the type of micrometer for measuring the dimension in column A.

	A. Dimensions	B. Types of Micrometers
7-32.	Piston travel in a cylinder	1. Inside
		2. Outside
7-33.	Diameter of a solid round bar	3. Depth
7-34.	Pitch diameter of a screw	4. Screw thread
7-35.	Bore of a cylinder	

7-36. The range of a micrometer is described as the
1. length of its frame
2. length of the largest work it will measure
3. distance the spindle advances with each revolution of the thimble
4. distance which the spindle can travel

7-37. What type of hammer or mallet should normally be used to straighten thin sheet metal ducting?
1. Ball peen hammer
2. Plastic mallet
3. Rawhide mallet
4. Metal hammer

7-38. If a hardened steel surface must be struck and a soft hammer is NOT available, the surface should be protected by a piece of
1. copper only
2. copper or brass only
3. brass or lead only
4. copper, brass, or lead

7-39. What type of hammer or mallet would you normally use to smooth out a metal surface that has been bent out of shape?
1. A rawhide mallet
2. A plastic mallet
3. A planishing hammer
4. A ball peen hammer

Learning Objective: Identify the functions of a rivet head shaver, and indicate uses and characteristics of pneumatic riveters.

7-40. What is the function of the rivet head shaver?
1. To countersink bucktails
2. To smooth countersunk rivet heads
3. To give an aerodynamic shape to bucktails
4. To countersink round and brazier head rivets

7-41. What rivet gun is preferred for driving medium-sized rivets?
1. Fast-hitting gun
2. One-shot gun
3. Squeeze riveter
4. Slow-hitting gun

7-42. The rivet gun which, because of its driving action, is sometimes referred to as a vibrator is the
1. fast-hitting gun
2. squeeze riveter
3. one-shot gun
4. slow-hitting gun

7-43. Rivet heads of the greatest uniformity are formed by which of the following?
1. Fast-hitting gun
2. Squeeze riveter
3. Slow-hitting gun
4. One-shot gun

In items 7-44 through 7-47, refer to figures 7-37 through 7-39 in your textbook. Select the components listed in column B that make up each puller listed in column A.

A. Pullers	B. Components
7-44. Universal bearing and bushing puller	1. A pressure screw with slide bar, a U-shaped body, a jaw holder, two large jaws, two small jaws, and two jaw pins
7-45. Push and pull puller set	2. A two- and three-way yoke, three medium jaws, two small jaws, and a locking feature
7-46. Universal wheel puller set	3. A body and drive assembly, three long jaws, a special grooved hub set, and tapered right- and left-hand threaded stud nuts
7-47. Slide hammer puller set	4. A 13 1/2-inch steel slotted bar to receive pairs of legs, of various lengths, a 1-inch threaded pressure screw 13 inches long, and numerous attachments and adapters

---

7-48. Refer to figure 7-44. When the universal push and puller set is used to remove a camshaft gear from an engine without removing the camshaft, the tightening force is applied to the
1. case
2. engine
3. camshaft
4. camshaft gear

7-49. Refer to figure 7-45. When the universal push and puller set is used to remove a bevel pinion shaft from a transmission, the tightening force is applied to the
1. bevel gear
2. pinion shaft
3. transmission case
4. cam gear

Learning Objective: Identify uses and operating characteristics and techniques of special tools and equipment used by the AS.

7-50. If a four-cycle engine's speed (rpm) is obtained by holding the tip of a manual tachometer against the camshaft, the speed is read as
1. four times the pointer indication on the dial
2. twice the pointer indication on the dial
3. the pointer indication on the dial
4. half the pointer indication on the dial

7-51. When used on a gasoline engine, where is the electric tachometer connected?
1. To the primary circuit
2. To the secondary circuit
3. To the battery circuit
4. To the number one spark plug

7-52. When the compression tester is used, how many engine revolutions are necessary to check the proper functioning of the rings, valves, and gaskets?
1. One
2. Two
3. Three
4. Four

7-53. Trouble which must be corrected before satisfactory engine performance can be expected is indicated if, after connecting a cylinder leakage tester to a cylinder, you can hear air escaping through the
1. carburetor only
2. exhaust pipe or the carburetor only
3. crankcase filler pipe only
4. exhaust pipe, carburetor, or crankcase filler pipe

7-54. When a vacuum gage is used, which of the following rules must be adhered to in order to obtain an accurate reading?
1. The gage must be placed or held in a vertical position
2. The connection between the intake manifold and the gage must be loose
3. All restrictions or dirt must be removed from the intake manifold and gage openings
4. The engine must be turned over one revolution

In items 7-55 through 7-58 concerning the use of the vacuum gage to diagnose engine trouble, select the malfunction from column B that causes each gage indication listed in column A.

	A. Indications	B. Malfuctions
7-55.	Reading changes slowly between 14 and 16 inches	1. Compression leak past the piston rings
7-56.	Reading of 15 inches when cruising at 40 mph	2. Valve triming incorrect
7-57.	Steady reading of 10 inches	3. Improper carburetion at idle
7-58.	Bouncing reading from normal to below normal and back	4. Sticking valve

---

7-59. Although smoke from an oil burning engine does NOT materially affect the reading of the exhaust gas analyzer, continued use of the analyzer on oil burning engines will
1. dull its sensitivity
2. cause irreparable corrosion problems
3. short out the analyzer
4. require replacement of the analyzer

7-60. Which of the following resistance creating devices may be used as a dynamometer to absorb energy?
1. A hydraulic cylinder
2. An electric armature revolving in a magnetic field
3. A fan revolving in compressed air
4. A mechanical spring

7-61. Which of the following statements concerning the chasis dynamometer is INCORRECT?
1. Its use eliminates the interference of body noise
2. It can be used to test and adjust automatic transmissions
3. It can be used to test an engine without removing the engine from the vehicle
4. It can be used to balance the front end

Learning Objective: In using special tools and equipment, identify operating and design characteristics, operating techniques, and uses.

7-62. Where is the ignition light hooked up for checking the timing on an engine?
1. To the number one cylinder
2. To the number two cylinder
3. To the number three cylinder
4. To the number four cylinder

7-63. In addition to removing small pits or burns from the faces of valves, the valve refacer can also be used to
1. square tappets
2. square valve stems
3. grind push rods
4. grind valve seats

In items 7-64 through 7-67, select the valve seat grinding component listed in column B that best fits the description listed in column A.

	A. Description of Components	B. Valve Seat Driver Component
7-64.	Available in three grades--cast iron, hard steel, and finishing	1. Driver
7-65.	Threaded on one end for attaching the stone	2. Pilot
7-66.	Has rigid axis for the grinding stone sleeve	3. Stone
7-67.	Positive vibrating action to minimize stone loading, speed up grinding, and reducing stone wear	4. Stone sleeve

7-68. The final process of fitting a newly ground valve on seat consists of rubbing the valve seating face against the valve seat. This is accomplished by using a

1. valve guide
2. valve lapper
3. valve refacer
4. self-centering valve guide pilot

7-69. If a valve spring is used that does NOT meet the tension requirements listed in the engine manufacturer's manual, all EXCEPT which of the following effects would result?

1. Undue wear on the valve operating mechanism
2. The valve may not seat properly
3. The valve may burn
4. The valve would elongate

7-70. What tool is used when the valve spring retaining locks are removed from the valve stem?

1. Valve spring tester
2. Self-centering valve guide pilot
3. Valve spring compressor
4. Valve retaining punch

7-71. When the spark plug cleaner is used, sand is air-blasted against the electrode end of a spark plug to

1. eliminate high-pressure plug firing failure
2. remove the cleaning solvent
3. eliminate too small a gap between electrodes
4. remove carbon deposits

Assignment 8

Hardware, Fuels, Lubricants, and Hydraulic Fluids

Text: Pages 7-44 through 8-31

Learning Objective: Indicate procedures for selecting hardware and materials, proper uses, and installation of hardware and consumables used in the AS rate.

8-1. What is the purpose of seals used throughout the systems of ground support equipment?
1. To increase friction
2. To minimize leakage
3. To facilitate alignment
4. To facilitate connections

8-2. Hardware used to seal sliding or moving assemblies in the shape of O-rings or other shapes is called
1. washers
2. gaskets
3. packings
4. bushings

8-3. Hardware used to seal nonmoving fittings and bosses is called
1. washers
2. gaskets
3. packings
4. bushings

8-4. Most O-rings used in support equipment installations are made of
1. natural rubber
2. synthetic rubber
3. Teflon
4. leather

8-5. O-ring packings are designed for which purpose? To seal units
1. in one direction only
2. in both directions
3. when pressure is applied only
4. under static conditions only

8-6. Backup rings are NOT required in hydraulic systems with less than what maximum pressure?
1. 1,000 psi
2. 1,500 psi
3. 3,000 psi
4. 3,500 psi

8-7. How are O-rings identified?
1. By the stamp on the O-ring
2. By color coding
3. By technical information printed on the O-ring
4. By technical information printed on the O-ring package

8-8. An O-ring manufactured in the third quarter of 1975 has a cure date on the package of
1. 1Q75
2. 2Q75
3. 3Q75
4. 4Q75

8-9. When selecting an O-ring, which of the following factors must the mechanic bear in mind?
1. Age limitation
2. Intended use
3. Material condition
4. All of the above

8-10. Deterioration of most synthetic rubber O-ring seals occurs if they are exposed to
1. thinners, moisture, or ozone
2. grease, fuel, or solvent
3. heat, light, or oil
4. any of the above

8-11. One of the primary factors concerning storage of O-ring seals is that the first ones placed in storage must be the first ones used.

8-12. When should the preservation of the O-ring be removed?
1. When ready for installation
2. After installation
3. Three hours prior to installation
4. Twelve hours prior to installation

8-13. During installation of an O-ring seal, an AS should use specific tools made from soft metal, phenolic rod, or plastic and be careful not to nick, scratch, or dent the seal.

8-14. A mandatory requirement for installation of a new O-ring is that the
1. system must be flushed before installation
2. O-ring must be used with a Teflon backup ring
3. part to receive the O-ring must be clean
4. O-ring must be used with a leather backup ring

8-15. Checking for small cracks or other irregularities on the inner surface of an O-ring may be accomplished by
1. stretching the O-ring to its elastic limits
2. rolling the O-ring inside out on a dowel or inspection cone
3. subjecting the O-ring to system pressure on a test stand
4. doing any of the above

8-16. When installing an O-ring over or through a threaded area of a component, which of the following should NOT be used to protect the ring from the threads?
1. Adhesive tape
2. An O-ring seal package
3. An O-ring entering sleeve
4. Lint-free bonding paper

8-17. What two types of backup rings are used in support equipment?
1. Leather and Teflon
2. Single-spiral and double-spiral
3. Expander and nonexpander
4. Right-hand spiral and left-hand spiral

8-18. Which of the following statements concerning Teflon backup rings is false?
1. They are unaffected by any fluid or vapor
2. They do not deteriorate with age
3. They are identified by their color code markings
4. They can withstand extreme temperatures

8-19. Refer to figure 8-9 in your textbook. After the fitting groove is examined for roughness, what step should you take next to install the leather-type backup ring?
1. Soak the backup ring in clean hydraulic fluid
2. Install the gasket in the fitting groove
3. Position the jamnut well above the fitting groove
4. Immerse the gasket in the same type hydraulic fluid as that used in the system

8-20. A Teflon spiral backup ring that is to be installed internally must have which type spiral?
1. Single
2. Double
3. Left-hand
4. Right-hand

8-21. A wiper in a hydraulic component serves to
1. clean and lubricate
2. trap excessive leakage
3. provide a bleed passage for internal leakage
4. clean the internal surface of the component

8-22. Gaskets should NOT be compressed against
1. end caps
2. smooth faces
3. torqued smoothed faces
4. irregular or rough surfaces

8-23. The purpose of the cylinder head gasket is to maintain a
1. gas and coolant-tight seal
2. gas and lubricant-tight seal
3. lubricant and coolant-tight seal
4. lubricant and air-tight seal

8-24. Intake and exhaust manifold gaskets are usually made from which of the following materials?
1. Neoprene
2. Cork
3. Asbestos
4. Oil resistant paper

8-25. When installing any gaskets in an engine, you should NEVER use heavy grease or gasket compounds because of the possibility of contamination.

Learning Objective: Recognize the classification methods, types and uses, and characteristics applicable to rivets and bolts. Identify the use and removal procedure of turnlock fasteners, and indicate the correct manner of installing safety wire.

8-26. What are the three principal parts of a bolt?
1. Head, thread, extender
2. Head, thread, shaft
3. Head, thread, grip
4. Head, thread, length

8-27. What is the grip length of a bolt?
1. The unused portion of the thread next to the shaft
2. The unused portion of all the threads
3. The length of the unthreaded portion of the shaft
4. The length of threads covered by the bolt

8-28. Safety wire should be installed in such a manner that
1. the tension of the wire tends to tighten the bolt or nut
2. the tension of the wire tends to loosen the bolt or nut
3. it is always as tight as possible
4. it has 5 turns per inch

8-29. Cotter pins made of which metal are best suited for a strong, corrosion resistant application?
1. Low-carbon steel
2. Stainless steel
3. Mild steel
4. Any of the above

Select the rivet shown in column B to be used under the conditions stated in column A.

	A. Conditions		B. Rivets
8-30.	Where maximum strength is required	1.	Countersunk
8-31.	Where streamlining is important	2.	Brazier head
8-32.	On an external surface	3.	Universal head
8-33.	In place of other protruding-head rivets (similar to brazier head rivets)	4.	Flat head

---

8-34. How are solid rivets classified?
1. By size
2. By material
3. By head shape
4. In all of the above ways

8-35. Which of the following types of rivets should be used to strengthen the sheet metal around the hole where streamlining is not important?
1. Countersunk
2. Flathead
3. Roundhead
4. Universal-head

8-36. What are the advantages of using blind rivets?
1. They do not require the use of a backing bar and are lightweight
2. They are lighter than standard rivets and do not require special tools
3. They are stronger than countersunk rivets and will fit holes that are not aligned
4. They do not cause spreading of the plates being fastened and are always true

8-37. Blind rivets include rivets of which of the following types?
1. Rivnuts
2. Self-plugging rivets (mechanical lock)
3. Self-plugging rivets (friction lock)
4. All of the above

8-38. What is the most desirable type of fastener for access panels on support equipment?
1. Machine screw
2. Turnlock fastener
3. Structural screw
4. Self-tapping screw

8-39. Which of the following parts of the airlock fastener is mounted in the door, cover, or removable section?
1. Stud
2. Spring
3. Spring assembly
4. Each of the above

Learning Objective: Recognize components, properties, characteristics, and stages of combustion of gasoline, and indicate causes, results, and remedies for detonation.

8-40. Which elements contained in gasoline make it burn freely in air?
1. Oxygen and hydrogen
2. Carbon and hydrogen
3. Carbon and oxygen
4. Carbon and nitrogen

8-41. Which property of gasoline determines its tendency to change from a liquid to a vapor at varying temperatures?
1. Purity
2. Antiknock quality
3. Volatility
4. Uniformity

8-42. The best way to prevent vapor lock during hot weather is to
1. insulate all parts of the fuel system from the hot engine parts
2. remove the engine thermostat so that the engine will run cooler
3. use a fuel of high volatility
4. use a fuel of low volatility

8-43. Excessive choking of an engine in cold weather should be avoided because it leaves excessive amounts of unvaporized fuel in the intake and combustion system which, in turn
1. prevents proper fuel-air mixture from entering the system
2. seeps into the crankcase and dilutes the lubricating oil
3. causes the engine to overspeed when it warms up
4. reduces the operational economy of the engine

In items 8-44 through 8-46, select from column B the stage of combustion in which each event listed in column A occurs.

	A. Events	B. Stages
8-44.	Effective burning occurs	1. Formation of a nucleus
8-45.	A small ball of blue flame develops in the gap of the spark plug electrodes	2. Hatching out 3. Propagation
8-46.	Fingers of flame are sent into the mixture in the combustion chamber	

8-47. Detonation can result in destruction of an engine. However, the most likely result of detonation is
1. high fuel consumption only
2. power loss only
3. overheating only
4. power loss, overheating, and high fuel consumption

8-48. The best way to minimize knocking or detonation is to
1. use hot spark plugs
2. put heavy oil in the crankcase to increase ring sealing capabilities thereby increasing compression in the cylinders
3. use a gasoline of the octane recommended for the engine
4. preheat the fuel prior to injection into the cylinders

8-49. How should the spark be adjusted with respect to the octane rating of a fuel?
1. Advance the spark when higher octane fuel is used
2. Retard the spark when higher octane fuel is used
3. Advance the spark when lower octane fuel is used
4. Either retard or advance the spark when higher octane fuel is used, depending on the heat rating of the spark plugs

8-50. Tetraethyl lead is added to gasoline for the purpose of
1. decreasing the volatility of the gasoline
2. improving the starting qualities of the gasoline
3. reducing the rate at which gasoline burns
4. increasing the octane rating of the gasoline

8-51. Since the Navy uses fuels of specified octane ratings, detonation in a support vehicle engine may be caused by
1. preignition only
2. a lean fuel mixture only
3. a defective cooling system only
4. a defective cooling system, a lean fuel mixture, or preignition

---

Learning Objective: Recognize requirements and characteristics of diesel fuels and engines.

8-52. Which quality of diesel fuel is considered the most important and necesssary?
1. Volatility
2. Viscosity
3. Cleanliness
4. Ignition quality

8-53. Why is water more objectionable in diesel fuel than in gasoline?
1. Diesel fuel must ignite without a spark and water reduces this capability
2. Diesel fuel is lighter than gasoline and mixes readily with water, and the filter system cannot prevent water from passing through the fuel system
3. Water causes rough running and also corrodes the injectors very quickly
4. The cooling effect of water retards diesel ignition

8-54. Which of the following statements concerning the viscosity of diesel fuel is correct?
1. The higher its viscosity, the less its resistance to flow
2. The higher its viscosity, the greater its resistance to flow
3. The lower its viscosity, the greater its resistance to flow
4. The viscosity of the fuel has no effect on its resistance to flow

8-55. Why do diesel engines knock when first started or when idling?
1. Diesel engines have a very high compression ratio and the fuel ignites too early
2. Diesel fuel does not burn fast enough at a low temperature or with low compression
3. There is a delay between the time of injection and ignition
4. Diesel engines have low compression and the fuel ignites too late

---

Learning Objective: Recognize requirements and characteristics of JP-5 fuel.

8-56. Two pounds of JP-5, while burning for one hour in a piston engine, produce approximately how many horsepower?
1. One horsepower
2. Five horsepower
3. Three horsepower
4. One-half horsepower

8-57. JP-5, with a vapor pressure of approximately 0 psi, is what type of fuel?
1. Gasoline
2. Kerosene
3. Diesel
4. AvGas

8-58. What type of additive is found in gasoline that is NOT found in JP-5?
1. Toluene
2. Xylene
3. Tetraethyl lead
4. Cumenelead

Learning Objective: Indicate functions, characteristics, purposes of additives, and uses of lubricating oils and greases.

8-59. Although the primary function of lubricating oil in an internal combustion engine is to prevent metal-to-metal contact of moving parts, it must also function as a
1. coolant only
2. cleanser only
3. sealing agent only
4. coolant, cleanser, and sealing agent

8-60. Which characteristic of lubricating oil is most important when you are determining the oil to use in a diesel engine equipped with an oil cooler?
1. Viscosity
2. Cleaning capability
3. Sealing quality
4. Oxygen absorption capability

8-61. Detergents are added to lubricating oils to aid in cleaning dirt, gum, and other impurities from the engine and then neutralizing them by
1. forming heavy globules with the impurities which then settle to the bottom of the pan
2. holding the impurities in suspension in the oil
3. forming large globules with the impurities which are then trapped in the filtering system
4. vaporizing the impurities so they can be vented from the crankcase

8-62. Why should lubricating oil be changed at regular intervals?
1. Because of its change in viscosity
2. Because of its increase in acid content
3. Because of its buildup of gum and varnish
4. Because dirt, gum, and other impurities are held in suspension in it

8-63. Under the system established by the Society of Automotive Engineers (SAE) for classifying lubricating oils, oil is characterized by its
1. specific gravity
2. flash and fire points
3. viscosity
4. detergent capability

8-64. In addition to its being used in the engine, lubricating oil is also used in the
1. gear unit transmission only
2. differential only
3. steering gear unit only
4. transmission, differential, and steering gear unit

8-65. Which of the following statements describes the viscosity characteristics of an oil with a low viscosity index?
1. It becomes thin at low temperatures and thick at high temperatures
2. It becomes thick at low temperatures and thin at high temperatures
3. It remains thin at all temperatues
4. It remains thick at all temperatures

Learning Objective: Recognize hazards and safety precautions associated with petroleum products.

8-66. What is the MILSPEC of the type of lube oil that is used in a gas turbine engine?
1. MIL-L-7808
2. MIL-L-9502
3. MIL-L-23699B
4. MIL-L-1010

8-67. In addition to satisfactory performance in operation, the most important requirements for grease include
1. stability only
2. noncorrosiveness only
3. water resistance only
4. stability, noncorrosiveness, and water resistance

8-68. In the manufacture of grease, soaps are added to regulate water resistance and
1. heat stability
2. corrosive action
3. oxidation
4. consistency

8-69. What property of hydraulic fluid indicates its desirable characteristics of resistance to combustion and evaporation?
1. A low viscosity index
2. A high flashpoint
3. Chemical stability
4. Freedom from acidity

8-70. The hydraulic fluid most commonly used in aviation support equipment has what type of base?
1. Petroleum
2. Vegetable
3. Synthetic
4. Mineral

8-71. Although the handling of all petroleum products can create hazards, what is the most hazardous to handle because of its toxic and highly combustible vapors?
1. Lubricating oil
2. Hydraulic fluid
3. Diesel fuel
4. Gasoline

8-72. Compared to the weight of air, vapors from petroleum products are
1. lighter
2. heavier
3. the same weight
4. either lighter or heavier, depending on which product is producing the vapors

8-73. What is the maximum time that a person may be exposed to petroleum vapors without serious effects?
1. 6 min
2. 10 min
3. 15 min
4. 20 min

8-74. What type of fire extinguisher is recommended for use on petroleum fires?
1. Dry chemical only
2. Water-acid
3. CO_2 only
4. Dry chemical or CO_2

Assignment 9

Corrosion

Text: Pages 8-31 through 9-20

Learning Objective: Recognize causes and effects of metal corrosion and indicate methods of corrosion prevention.

9-1. Why is carrier-based ground support equipment more susceptible to corrosion than land-based ground support equipment located at NAS Memphis?
1. Because salt water is a primary source of corrosion
2. Because the mechanical stresses placed on the carrier-based equipment are more severe than those placed on land-based equipment
3. Because the alloys used in the carrier-based equipment corrode easier than the alloys used in land-based equipment
4. Because of all of the above

9-2. Since the AS must know the types and methods of application of corrosion prevention and moisture protecting materials, he must be able to detect corrosion on support equipment and parts, and he must also be familiar with
1. the materials and procedures for preservation and depreservation
2. the types and uses of cleaning materials
3. the types and causes of corrosion
4. all of the above

9-3. The most significant factor in causing a refined base metal to return to its natural state is the presence of
1. heat
2. oxygen
3. salt water
4. moisture-laden air, whether fresh or salt

9-4. Which of the following methods is commonly used for preventing most types of corrosion in support equipment?
1. Painting
2. Sealing
3. Preserving
4. Using shrouds, covers, and caps

9-5. Salt water causes electrochemical corrosion because it furnishes both the corrosive agents and
1. a path of decay
2. the chemical conductor
3. a chemical neutralizer
4. the electrical conductor

9-6. Which of the following statements relative to the flow of electrons during electrochemical attack of metal is correct?
1. Electrons flow from the cathodic area to the anodic area resulting in deterioration of the cathodic area
2. Electrons flow from the anodic area to the cathodic area resulting in deterioration of the cathodic area
3. Electrons flow from the anodic area to the cathodic area resulting in deterioration of the anodic area
4. Electrons flow from the cathodic area to the anodic area resulting in deterioration of the anodic area

9-7. A secondary factor that a manufacturer must consider in his selection of materials for ground support equipment construction is their corrosion resistant properties.

9-8. The most practical, positive means of deterring corrosion is by
1. preventive maintenance
2. keeping equipment subject to corrosion away from a corrosive environment
3. educating all hands to be able to recognize the different forms of corrosion
4. ensuring that no dissimilar metals are used in the construction of any equipment subject to a corrosive environment

In items 9-9 through 9-11, select from column B the metal whose corrosion takes on the appearance listed in column A.

A. Appearances

9-9. Red rust

9-10. White to gray powdery deposit

9-11. Dull gray-green

B. Metals

1. Copper and its alloys
2. Iron and steel sheet stock
3. Magnesium and its alloys
4. Aluminum and its alloys

Learning Objective: Identify typical corrosion characteristics of the various common metals.

9-12. The most easily recognized form of metal corrosion occurs on
1. copper
2. iron and steel
3. magnesium

9-13. Corrosion on a structure fabricated from which metal requires prompt attention because it can penetrate the metal in a very short time?
1. Chromium
2. Cadmium
3. Iron and steel sheet
4. Magnesium

9-14. Which metal is generally corrosion resistant?
1. Copper
2. Chromium
3. Magnesium
4. Cadmium

9-15. Which metal, when used as a coating to protect the part to which it is applied, protects the base metal by being intentionally consumed?
1. Chromium
2. Iron and steel
3. Cadmium
4. Copper

9-16. Which metal, when electroplated on steel, is somewhat porous and will allow corrosion to start at the pores unless a supplementary coating is applied and maintained?
1. Chromium
2. Copper
3. Iron
4. Cadmium

9-17. Microbiological corrosion will not occur on aluminum alloys.

9-18. Exfoliation corrosion is most commonly found on grain boundaries just below the metal's surface.

9-19. Which form of corrosion occurs when the failure of an insulation allows steel and aluminum to come in direct contact with one another?
1. Stress
2. Fatigue
3. Fretting
4. Galvanic

Learning Objective: Indicate the forms, causes, and identifying features of corrosion and recognize the probable areas of corrosion.

9-20. A greater degree of corrosion occurs when two aluminum surfaces are joined with a Monel rivet than when two Monel surfaces are joined with an aluminum rivet.

9-21. Which form of corrosion first appears on the surface of aluminum alloys as a white or gray dusty deposit which, when cleaned away, reveals tiny holes in the surface?
1. Pitting
2. Exfoliation
3. Uniform etch
4. Intergranular

9-22. Which form of corrosion may exist without any visible evidence on the outer surface of the metal?
1. Stress
2. Fatigue
3. Galvanic
4. Intergranular

9-23. The presence of stress corrosion in metal is indicated by
1. sweats
2. cracks
3. bends
4. shrinks

In items 9-24 through 9-26, select from column B a cause of each type of corrosion listed in column A.

A. Types	B. Causes
9-24. Stress	1. Alternating loads are applied in cycles to a part.
9-25. Fatigue	2. The individual grains of the different elements in an alloy react with one another.
9-26. Fretting	3. Vibration occurs between two connecting surfaces which are heavily loaded and under stress.
	4. Static stresses under corrosive conditions are applied to a surface for a period of time.

9-27. On ground support equipment, which material is used most often to separate metal from the corrosion environment?
1. Paints
2. Sealants
3. Preservatives
4. Shrounds, covers, and caps

9-28. Which of the following instructions requires GSE shops to establish a preventive maintenance schedule for all items of equipment?
1. OPNAVINST 4790.5D
2. OPNAVINST 4790.2
3. OPNAVINST 4790.6
4. All of the above

9-29. Which of the following forms can be used to schedule and record corrosion maintenance actions?
1. OPNAV Form 4790/51
2. OPNAV Form 4790/59
3. OPNAV Form 4790/60
4. OPNAV Form 4790/61

Learning Objective: Indicate methods and procedures relative to the removal and control of corrosion on different metal surfaces and to the stripping of painted surfaces.

9-30. After cleaning ground support equipment, how should you dry water from hinges and latches?
1. Low-pressure air blast
2. Use lint-free rags
3. Park equipment in the sun
4. Spray with corrosion preventive compound

9-31. When preparing ground support equipment for storage, the term preservation means
1. painting any unprotected surfaces
2. providing protection to surface-damaged areas
3. preventing salt water spray from reaching the equipment
4. both 1 and 2 above

9-32. Which of the following statements is correct concerning repair of corroded surfaces?
1. Paint and corrosion must be removed to bare metal
2. Corrosion must be removed and paint feathered
3. Paint and corrosion must be sanded smooth
4. Corrosion only needs to be removed

9-33. What are the two methods for removing corrosion?
1. Mechanical and chemical
2. Sanding and blasting
3. Hand and powered tools
4. Acid and detergent washing

9-34. After you have cleaned and painted a corroded surface, what is the most common cause of the paint peeling?
1. Poor painting techniques
2. Improper mixing of paint
3. Surface not properly prepared
4. Improper painting facilities

9-35. After properly cleaning a corroded surface, you must apply a protective coating immediately to prevent corrosion from restarting.

9-36. What is the first step that should be taken in cleaning an item of equipment?
1. Selecting the proper cleaning agent for the method to be used
2. Grounding the equipment
3. Placing the equipment in the shade or beneath an overhead shelter if possible
4. Covering or plugging all ducts and openings on the equipment where cleaning fluid or water could be trapped

9-37. Hazards associated with the use of solvents for cleaning support equipment include
1. the danger that the solvents may ignite or explode
2. the effect that the solvents may have when used on oxygen equipment
3. the toxic effect the solvents may have on the user if he breathes their vapors for a prolonged period of time
4. all of the above

9-38. The most efficient and inexpensive method of removing grease from an item of support equipment that is only slightly contaminated is
1. steam cleaning
2. emulsion cleaning
3. chemical cleaning
4. alkaline cleaning

9-39. What cleaning method is recommended for removing heavy oil and grease from surface areas of ground support equipment?
1. Steam cleaning
2. Emulsion cleaning
3. Chemical cleaning
4. Water wash

9-40. Which cleaning method requires a thorough rinse with clean water?
1. Steam cleaning
2. Acid cleaning
3. Solvent cleaning
4. Abrasive blasting

9-41. What method of cleaning ground support equipment requires that the personnel who operate the cleaning equipment wear breathing devices, face shields, and protective clothing?
1. Abrasive blasting
2. Emulsion cleaning
3. Chemical cleaning
4. Water wash

9-42. Which of the following methods is best for obtaining the clean anchor pattern necessary for most coating systems?
1. Abrasive blasting
2. Alkaline cleaning
3. Acid cleaning
4. Solvent cleaning

9-43. Abrasive grit, once used on steel, cannot be recycled and used on aluminum.

9-44. Why is sodium nitrite, MIL-S-24521, required when using the wet abrasive blasting method of cleaning corrosion?
1. To prevent flash rusting
2. To retard rusting after painting
3. To ensure primer adheres to base metal
4. To prepare unit for storage

9-45. What type of corrosion removal process should never be used on aluminum?
1. Wet abrasive blasting
2. Acid cleaning
3. Solvent cleaning
4. Power-tool cleaning

9-46. Since painted surfaces can be easily damaged by the careless use of handtools and power tools, minutes of extra time in the careful use of these tools can result in the saving of hours of paint touchups and corrosion removal work later.

9-47. The most ineffective method used for corrosion removal is
1. abrasive blasting
2. hand-tool cleaning
3. power-tool cleaning
4. solvent cleaning

9-48. If chemical paint removers contact the skin, you should NEVER do which of the following?
1. Wash with soap and water
2. Apply salves or ointments
3. Obtain medical aid
4. Rinse area with alcohol

9-49. A complete coating system usually consists of
1. primer
2. chemical conversion
3. finish
4. all of the above

9-50. Chemical conversion coatings used to treat steel surfaces usually have what base compounds?
1. Oxides
2. Phosphates
3. Sulfurics
4. Chromates

9-51. Chemical conversion coatings used to treat aluminum surfaces usually have what base compounds?
1. Oxides
2. Phosphates
3. Sulfurics
4. Combination of 2 and 3 above

9-52. Primers used to provide a compatible adhesion layer between paints and base metals are classified as
1. barriers
2. corrosion-inhibitors
3. sacrificials
4. all of the above

9-53. Epoxy primers are always used with epoxy finish coatings and polyurethane primers are used with polyurethane finish coatings.

9-54. Zinc chromate is a good sacrificial and barrier-type primer that should be used on ground support equipment.

9-55. What is the set-up time, if any, for epoxy polyamide before you spray it on a prepared surface?
1. 15 minutes
2. 30 minutes
3. 60 minutes
4. No set-up time is required

9-56. What are the primary functions of finish coatings?
1. Undercoat protection and color decoration
2. Visual appeal and exposure resistance
3. Covering defects in the surface and undercoat protection
4. Color decoration and covering defects in the surface

9-57. Which of the following instructions should you refer to for the optimum paint finish, regardless of the type paint you are using?
1. Ground support equipment corrosion manual
2. Aircraft weapons systems cleaning and corrosion control manual
3. The paint manufacturer's instructions and directives
4. Material furnished by NAMTRADETs

9-58. If you are to completely repaint an MD-3A tow tractor, what type of paint should be used?
1. Epoxy polyamide
2. Acrylic nitrocellulose
3. Polyurethane
4. Acrylic enamel

9-59. Before painting with polyurethane, you must have a special physical examination and be certified as having no respiratory problems.

9-60. The Ground Support Equipment Corrosion Control Manual, NAVAIR 17-1-125
1. takes precedence over all MIMS
2. lists all procedures and materials used for GSE corrosion control
3. shows corrosion-prone areas on GSE
4. does all of the above

COURSE DISENROLLMENT

All study materials must be returned. On disenrolling, fill out only the upper part of this page and attach it to the inside front cover of the textbook for this course. Mail your study materials to the Naval Education and Training Program Development Center.

PRINT CLEARLY

NAVEDTRA NUMBER 10325	COURSE TITLE Aviation Support Equipment Technician (ASE 3 & 2 and ASM 3 & 2) Volume 1, Basics

Name Last First Middle

Rank/Rate Designator Social Security Number

COURSE COMPLETION

Letters of satisfactory completion are issued only to personnel whose courses are administered by the Naval Education and Training Program Development Center. On completing the course, fill out the lower part of this page and enclose it with your last set of answer sheets. Be sure mailing addresses are complete. Mail to the Naval Education and Training Program Development Center.

PRINT CLEARLY

NAVEDTRA NUMBER 10325	COURSE TITLE Aviation Support Equipment Technician (ASE 3 & 2 and ASM 3 & 2) Volume 1, Basics

Name

ZIP CODE

MY SERVICE RECORD IS HELD BY:

Activity

Address ZIP CODE

Signature of enrollee

A FINAL QUESTION: What did you think of this course? Of the text material used with the course? Comments and recommendations received from enrollees have been a major source of course improvement. You and your command are urged to submit your constructive criticisms and your recommendations. This tear-out form letter is provided for your convenience. Typewrite if possible, but legible handwriting is acceptable.

Date ____________________

From: ______________________________
(RANK, RATE, CIVILIAN)
____
______________________________ ZIP CODE __________

To: Naval Education and Training Program Development Center (PD 10)
Pensacola, Florida 32509

Subj: RTM/NRCC Aviation Support Equipment Technician (ASE 3 & 2 and ASM 3 & 2) Volume 1, Basics, NAVEDTRA 10325

1. The following comments are hereby submitted:

(Fold along dotted line and staple or tape)

....

(Fold along dotted line and staple or tape)

....

DEPARTMENT OF THE NAVY
NAVAL EDUCATION AND TRAINING PROGRAM
DEVELOPMENT CENTER (PD 10)
PENSACOLA, FLORIDA 32509

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
NAVY DEPARTMENT
DoD-316

NAVAL EDUCATION AND TRAINING PROGRAM DEVELOPMENT CENTER
BUILDING 2435 (PD 10)
PENSACOLA, FLORIDA 32509

PRINT OR TYPE

Aviation Support Equipment Technician
(ASE 3&2, ASM 3&2) Vol. 1, Basics
NAVEDTRA 10325

NAME ______________________________ ADDRESS ______________________________
Last First Middle Street/Ship/Unit/Division, etc.

____
City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ______________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ______________ DATE MAILED ________

SCORE ☐

1 2 3 4
T F

1 ☐☐☐☐ -----
2 ☐☐☐☐ -----
3 ☐☐☐☐ -----
4 ☐☐☐☐ -----
5 ☐☐☐☐ -----
6 ☐☐☐☐ -----
7 ☐☐☐☐ -----
8 ☐☐☐☐ -----
9 ☐☐☐☐ -----
10 ☐☐☐☐ -----
11 ☐☐☐☐ -----
12 ☐☐☐☐ -----
13 ☐☐☐☐ -----
14 ☐☐☐☐ -----
15 ☐☐☐☐ -----
16 ☐☐☐☐ -----
17 ☐☐☐☐ -----
18 ☐☐☐☐ -----
19 ☐☐☐☐ -----
20 ☐☐☐☐ -----
21 ☐☐☐☐ -----
22 ☐☐☐☐ -----
23 ☐☐☐☐ -----
24 ☐☐☐☐ -----
25 ☐☐☐☐ -----

1 2 3 4
T F

26 ☐☐☐☐ -----
27 ☐☐☐☐ -----
28 ☐☐☐☐ -----
29 ☐☐☐☐ -----
30 ☐☐☐☐ -----
31 ☐☐☐☐ -----
32 ☐☐☐☐ -----
33 ☐☐☐☐ -----
34 ☐☐☐☐ -----
35 ☐☐☐☐ -----
36 ☐☐☐☐ -----
37 ☐☐☐☐ -----
38 ☐☐☐☐ -----
39 ☐☐☐☐ -----
40 ☐☐☐☐ -----
41 ☐☐☐☐ -----
42 ☐☐☐☐ -----
43 ☐☐☐☐ -----
44 ☐☐☐☐ -----
45 ☐☐☐☐ -----
46 ☐☐☐☐ -----
47 ☐☐☐☐ -----
48 ☐☐☐☐ -----
49 ☐☐☐☐ -----
50 ☐☐☐☐ -----

1 2 3 4
T F

51 ☐☐☐☐ -----
52 ☐☐☐☐ -----
53 ☐☐☐☐ -----
54 ☐☐☐☐ -----
55 ☐☐☐☐ -----
56 ☐☐☐☐ -----
57 ☐☐☐☐ -----
58 ☐☐☐☐ -----
59 ☐☐☐☐ -----
60 ☐☐☐☐ -----
61 ☐☐☐☐ -----
62 ☐☐☐☐ -----
63 ☐☐☐☐ -----
64 ☐☐☐☐ -----
65 ☐☐☐☐ -----
66 ☐☐☐☐ -----
67 ☐☐☐☐ -----
68 ☐☐☐☐ -----
69 ☐☐☐☐ -----
70 ☐☐☐☐ -----
71 ☐☐☐☐ -----
72 ☐☐☐☐ -----
73 ☐☐☐☐ -----
74 ☐☐☐☐ -----
75 ☐☐☐☐ -----

PRINT OR TYPE

Aviation Support Equipment Technician
(ASE 362, ASM 362) Vol. 1, Basics
NAVEDTRA 10325

NAME ______________________ ADDRESS ______________________
Last First Middle
Street/Ship/Unit/Division, etc.
____
City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ______________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ______________ DATE MAILED ________

SCORE

1 2 3 4
T F
1 ☐☐☐☐ -----
2 ☐☐☐☐ -----
3 ☐☐☐☐ -----
4 ☐☐☐☐ -----
5 ☐☐☐☐ -----
6 ☐☐☐☐ -----
7 ☐☐☐☐ -----
8 ☐☐☐☐ -----
9 ☐☐☐☐ -----
10 ☐☐☐☐ -----
11 ☐☐☐☐ -----
12 ☐☐☐☐ -----
13 ☐☐☐☐ -----
14 ☐☐☐☐ -----
15 ☐☐☐☐ -----
16 ☐☐☐☐ -----
17 ☐☐☐☐ -----
18 ☐☐☐☐ -----
19 ☐☐☐☐ -----
20 ☐☐☐☐ -----
21 ☐☐☐☐ -----
22 ☐☐☐☐ -----
23 ☐☐☐☐ -----
24 ☐☐☐☐ -----
25 ☐☐☐☐ -----

1 2 3 4
T F
26 ☐☐☐☐ -----
27 ☐☐☐☐ -----
28 ☐☐☐☐ -----
29 ☐☐☐☐ -----
30 ☐☐☐☐ -----
31 ☐☐☐☐ -----
32 ☐☐☐☐ -----
33 ☐☐☐☐ -----
34 ☐☐☐☐ -----
35 ☐☐☐☐ -----
36 ☐☐☐☐ -----
37 ☐☐☐☐ -----
38 ☐☐☐☐ -----
39 ☐☐☐☐ -----
40 ☐☐☐☐ -----
41 ☐☐☐☐ -----
42 ☐☐☐☐ -----
43 ☐☐☐☐ -----
44 ☐☐☐☐ -----
45 ☐☐☐☐ -----
46 ☐☐☐☐ -----
47 ☐☐☐☐ -----
48 ☐☐☐☐ -----
49 ☐☐☐☐ -----
50 ☐☐☐☐ -----

1 2 3 4
T F
51 ☐☐☐☐ -----
52 ☐☐☐☐ -----
53 ☐☐☐☐ -----
54 ☐☐☐☐ -----
55 ☐☐☐☐ -----
56 ☐☐☐☐ -----
57 ☐☐☐☐ -----
58 ☐☐☐☐ -----
59 ☐☐☐☐ -----
60 ☐☐☐☐ -----
61 ☐☐☐☐ -----
62 ☐☐☐☐ -----
63 ☐☐☐☐ -----
64 ☐☐☐☐ -----
65 ☐☐☐☐ -----
66 ☐☐☐☐ -----
67 ☐☐☐☐ -----
68 ☐☐☐☐ -----
69 ☐☐☐☐ -----
70 ☐☐☐☐ -----
71 ☐☐☐☐ -----
72 ☐☐☐☐ -----
73 ☐☐☐☐ -----
74 ☐☐☐☐ -----
75 ☐☐☐☐ -----

PRINT OR TYPE

Aviation Support Equipment Technician
(ASE 3&2, ASM 3&2) Vol. 1, Basics
NAVEDTRA 10325

NAME ______________________________ ADDRESS ______________________________
Last First Middle
Street/Ship/Unit/Division, etc.
____
City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ________________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ______________ DATE MAILED ________

SCORE

1 2 3 4
T F
1 ☐☐☐☐ _____
2 ☐☐☐☐ _____
3 ☐☐☐☐ _____
4 ☐☐☐☐ _____
5 ☐☐☐☐ _____
6 ☐☐☐☐ _____
7 ☐☐☐☐ _____
8 ☐☐☐☐ _____
9 ☐☐☐☐ _____
10 ☐☐☐☐ _____
11 ☐☐☐☐ _____
12 ☐☐☐☐ _____
13 ☐☐☐☐ _____
14 ☐☐☐☐ _____
15 ☐☐☐☐ _____
16 ☐☐☐☐ _____
17 ☐☐☐☐ _____
18 ☐☐☐☐ _____
19 ☐☐☐☐ _____
20 ☐☐☐☐ _____
21 ☐☐☐☐ _____
22 ☐☐☐☐ _____
23 ☐☐☐☐ _____
24 ☐☐☐☐ _____
25 ☐☐☐☐ _____

1 2 3 4
T F
26 ☐☐☐☐ _____
27 ☐☐☐☐ _____
28 ☐☐☐☐ _____
29 ☐☐☐☐ _____
30 ☐☐☐☐ _____
31 ☐☐☐☐ _____
32 ☐☐☐☐ _____
33 ☐☐☐☐ _____
34 ☐☐☐☐ _____
35 ☐☐☐☐ _____
36 ☐☐☐☐ _____
37 ☐☐☐☐ _____
38 ☐☐☐☐ _____
39 ☐☐☐☐ _____
40 ☐☐☐☐ _____
41 ☐☐☐☐ _____
42 ☐☐☐☐ _____
43 ☐☐☐☐ _____
44 ☐☐☐☐ _____
45 ☐☐☐☐ _____
46 ☐☐☐☐ _____
47 ☐☐☐☐ _____
48 ☐☐☐☐ _____
49 ☐☐☐☐ _____
50 ☐☐☐☐ _____

1 2 3 4
T F
51 ☐☐☐☐ _____
52 ☐☐☐☐ _____
53 ☐☐☐☐ _____
54 ☐☐☐☐ _____
55 ☐☐☐☐ _____
56 ☐☐☐☐ _____
57 ☐☐☐☐ _____
58 ☐☐☐☐ _____
59 ☐☐☐☐ _____
60 ☐☐☐☐ _____
61 ☐☐☐☐ _____
62 ☐☐☐☐ _____
63 ☐☐☐☐ _____
64 ☐☐☐☐ _____
65 ☐☐☐☐ _____
66 ☐☐☐☐ _____
67 ☐☐☐☐ _____
68 ☐☐☐☐ _____
69 ☐☐☐☐ _____
70 ☐☐☐☐ _____
71 ☐☐☐☐ _____
72 ☐☐☐☐ _____
73 ☐☐☐☐ _____
74 ☐☐☐☐ _____
75 ☐☐☐☐ _____

PRINT OR TYPE

Aviation Support Equipment Technician
(ASE 3&2, ASM 3&2) Vol. 1, Basics
NAVEDTRA 10325

NAME ______________________________ (Last) (First) (Middle) ADDRESS ______________________________ (Street/Ship/Unit/Division, etc.)

______________________________ (City or FPO) (State) (Zip)

RANK/RATE ________ SOC. SEC. NO. ____________________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ____________________ DATE MAILED ________

SCORE ☐

	1	2	3	4	
	T	F			
1	☐	☐	☐	☐	_____
2	☐	☐	☐	☐	_____
3	☐	☐	☐	☐	_____
4	☐	☐	☐	☐	_____
5	☐	☐	☐	☐	_____
6	☐	☐	☐	☐	_____
7	☐	☐	☐	☐	_____
8	☐	☐	☐	☐	_____
9	☐	☐	☐	☐	_____
10	☐	☐	☐	☐	_____
11	☐	☐	☐	☐	_____
12	☐	☐	☐	☐	_____
13	☐	☐	☐	☐	_____
14	☐	☐	☐	☐	_____
15	☐	☐	☐	☐	_____
16	☐	☐	☐	☐	_____
17	☐	☐	☐	☐	_____
18	☐	☐	☐	☐	_____
19	☐	☐	☐	☐	_____
20	☐	☐	☐	☐	_____
21	☐	☐	☐	☐	_____
22	☐	☐	☐	☐	_____
23	☐	☐	☐	☐	_____
24	☐	☐	☐	☐	_____
25	☐	☐	☐	☐	_____
	1	2	3	4	
	T	F			
26	☐	☐	☐	☐	_____
27	☐	☐	☐	☐	_____
28	☐	☐	☐	☐	_____
29	☐	☐	☐	☐	_____
30	☐	☐	☐	☐	_____
31	☐	☐	☐	☐	_____
32	☐	☐	☐	☐	_____
33	☐	☐	☐	☐	_____
34	☐	☐	☐	☐	_____
35	☐	☐	☐	☐	_____
36	☐	☐	☐	☐	_____
37	☐	☐	☐	☐	_____
38	☐	☐	☐	☐	_____
39	☐	☐	☐	☐	_____
40	☐	☐	☐	☐	_____
41	☐	☐	☐	☐	_____
42	☐	☐	☐	☐	_____
43	☐	☐	☐	☐	_____
44	☐	☐	☐	☐	_____
45	☐	☐	☐	☐	_____
46	☐	☐	☐	☐	_____
47	☐	☐	☐	☐	_____
48	☐	☐	☐	☐	_____
49	☐	☐	☐	☐	_____
50	☐	☐	☐	☐	_____
	1	2	3	4	
	T	F			
51	☐	☐	☐	☐	_____
52	☐	☐	☐	☐	_____
53	☐	☐	☐	☐	_____
54	☐	☐	☐	☐	_____
55	☐	☐	☐	☐	_____
56	☐	☐	☐	☐	_____
57	☐	☐	☐	☐	_____
58	☐	☐	☐	☐	_____
59	☐	☐	☐	☐	_____
60	☐	☐	☐	☐	_____
61	☐	☐	☐	☐	_____
62	☐	☐	☐	☐	_____
63	☐	☐	☐	☐	_____
64	☐	☐	☐	☐	_____
65	☐	☐	☐	☐	_____
66	☐	☐	☐	☐	_____
67	☐	☐	☐	☐	_____
68	☐	☐	☐	☐	_____
69	☐	☐	☐	☐	_____
70	☐	☐	☐	☐	_____
71	☐	☐	☐	☐	_____
72	☐	☐	☐	☐	_____
73	☐	☐	☐	☐	_____
74	☐	☐	☐	☐	_____
75	☐	☐	☐	☐	_____

PRINT OR TYPE

Aviation Support Equipment Technician
(ASE 3&2, ASM 3&2) Vol. 1, Basics
NAVEDTRA 10325

NAME ______________________ ADDRESS ______________________
Last First Middle Street/Ship/Unit/Division, etc.

____
City or FPO State Zip

RANK/RATE ______ SOC. SEC. NO. ______________ DESIGNATOR ______ ASSIGNMENT NO. ______

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ______________ DATE MAILED ______

SCORE

1 2 3 4
T F

1 ☐☐☐☐ _____
2 ☐☐☐☐ _____
3 ☐☐☐☐ _____
4 ☐☐☐☐ _____
5 ☐☐☐☐ _____
6 ☐☐☐☐ _____
7 ☐☐☐☐ _____
8 ☐☐☐☐ _____
9 ☐☐☐☐ _____
10 ☐☐☐☐ _____
11 ☐☐☐☐ _____
12 ☐☐☐☐ _____
13 ☐☐☐☐ _____
14 ☐☐☐☐ _____
15 ☐☐☐☐ _____
16 ☐☐☐☐ _____
17 ☐☐☐☐ _____
18 ☐☐☐☐ _____
19 ☐☐☐☐ _____
20 ☐☐☐☐ _____
21 ☐☐☐☐ _____
22 ☐☐☐☐ _____
23 ☐☐☐☐ _____
24 ☐☐☐☐ _____
25 ☐☐☐☐ _____

1 2 3 4
T F

26 ☐☐☐☐ _____
27 ☐☐☐☐ _____
28 ☐☐☐☐ _____
29 ☐☐☐☐ _____
30 ☐☐☐☐ _____
31 ☐☐☐☐ _____
32 ☐☐☐☐ _____
33 ☐☐☐☐ _____
34 ☐☐☐☐ _____
35 ☐☐☐☐ _____
36 ☐☐☐☐ _____
37 ☐☐☐☐ _____
38 ☐☐☐☐ _____
39 ☐☐☐☐ _____
40 ☐☐☐☐ _____
41 ☐☐☐☐ _____
42 ☐☐☐☐ _____
43 ☐☐☐☐ _____
44 ☐☐☐☐ _____
45 ☐☐☐☐ _____
46 ☐☐☐☐ _____
47 ☐☐☐☐ _____
48 ☐☐☐☐ _____
49 ☐☐☐☐ _____
50 ☐☐☐☐ _____

1 2 3 4
T F

51 ☐☐☐☐ _____
52 ☐☐☐☐ _____
53 ☐☐☐☐ _____
54 ☐☐☐☐ _____
55 ☐☐☐☐ _____
56 ☐☐☐☐ _____
57 ☐☐☐☐ _____
58 ☐☐☐☐ _____
59 ☐☐☐☐ _____
60 ☐☐☐☐ _____
61 ☐☐☐☐ _____
62 ☐☐☐☐ _____
63 ☐☐☐☐ _____
64 ☐☐☐☐ _____
65 ☐☐☐☐ _____
66 ☐☐☐☐ _____
67 ☐☐☐☐ _____
68 ☐☐☐☐ _____
69 ☐☐☐☐ _____
70 ☐☐☐☐ _____
71 ☐☐☐☐ _____
72 ☐☐☐☐ _____
73 ☐☐☐☐ _____
74 ☐☐☐☐ _____
75 ☐☐☐☐ _____

PRINT OR TYPE

Aviation Support Equipment Technician
(ASE 3&2, ASM 3&2) Vol. 1, Basics
NAVEDTRA 10325

NAME ______________________________ Last First Middle

ADDRESS ______________________________ Street/Ship/Unit/Division, etc.

______________________________ City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ______________________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ______________ DATE MAILED ________

SCORE ☐

1 2 3 4
T F
1 ☐ ☐ ☐ ☐ _____
2 ☐ ☐ ☐ ☐ _____
3 ☐ ☐ ☐ ☐ _____
4 ☐ ☐ ☐ ☐ _____
5 ☐ ☐ ☐ ☐ _____
6 ☐ ☐ ☐ ☐ _____
7 ☐ ☐ ☐ ☐ _____
8 ☐ ☐ ☐ ☐ _____
9 ☐ ☐ ☐ ☐ _____
10 ☐ ☐ ☐ ☐ _____
11 ☐ ☐ ☐ ☐ _____
12 ☐ ☐ ☐ ☐ _____
13 ☐ ☐ ☐ ☐ _____
14 ☐ ☐ ☐ ☐ _____
15 ☐ ☐ ☐ ☐ _____
16 ☐ ☐ ☐ ☐ _____
17 ☐ ☐ ☐ ☐ _____
18 ☐ ☐ ☐ ☐ _____
19 ☐ ☐ ☐ ☐ _____
20 ☐ ☐ ☐ ☐ _____
21 ☐ ☐ ☐ ☐ _____
22 ☐ ☐ ☐ ☐ _____
23 ☐ ☐ ☐ ☐ _____
24 ☐ ☐ ☐ ☐ _____
25 ☐ ☐ ☐ ☐ _____

1 2 3 4
T F
26 ☐ ☐ ☐ ☐ _____
27 ☐ ☐ ☐ ☐ _____
28 ☐ ☐ ☐ ☐ _____
29 ☐ ☐ ☐ ☐ _____
30 ☐ ☐ ☐ ☐ _____
31 ☐ ☐ ☐ ☐ _____
32 ☐ ☐ ☐ ☐ _____
33 ☐ ☐ ☐ ☐ _____
34 ☐ ☐ ☐ ☐ _____
35 ☐ ☐ ☐ ☐ _____
36 ☐ ☐ ☐ ☐ _____
37 ☐ ☐ ☐ ☐ _____
38 ☐ ☐ ☐ ☐ _____
39 ☐ ☐ ☐ ☐ _____
40 ☐ ☐ ☐ ☐ _____
41 ☐ ☐ ☐ ☐ _____
42 ☐ ☐ ☐ ☐ _____
43 ☐ ☐ ☐ ☐ _____
44 ☐ ☐ ☐ ☐ _____
45 ☐ ☐ ☐ ☐ _____
46 ☐ ☐ ☐ ☐ _____
47 ☐ ☐ ☐ ☐ _____
48 ☐ ☐ ☐ ☐ _____
49 ☐ ☐ ☐ ☐ _____
50 ☐ ☐ ☐ ☐ _____

1 2 3 4
T F
51 ☐ ☐ ☐ ☐ _____
52 ☐ ☐ ☐ ☐ _____
53 ☐ ☐ ☐ ☐ _____
54 ☐ ☐ ☐ ☐ _____
55 ☐ ☐ ☐ ☐ _____
56 ☐ ☐ ☐ ☐ _____
57 ☐ ☐ ☐ ☐ _____
58 ☐ ☐ ☐ ☐ _____
59 ☐ ☐ ☐ ☐ _____
60 ☐ ☐ ☐ ☐ _____
61 ☐ ☐ ☐ ☐ _____
62 ☐ ☐ ☐ ☐ _____
63 ☐ ☐ ☐ ☐ _____
64 ☐ ☐ ☐ ☐ _____
65 ☐ ☐ ☐ ☐ _____
66 ☐ ☐ ☐ ☐ _____
67 ☐ ☐ ☐ ☐ _____
68 ☐ ☐ ☐ ☐ _____
69 ☐ ☐ ☐ ☐ _____
70 ☐ ☐ ☐ ☐ _____
71 ☐ ☐ ☐ ☐ _____
72 ☐ ☐ ☐ ☐ _____
73 ☐ ☐ ☐ ☐ _____
74 ☐ ☐ ☐ ☐ _____
75 ☐ ☐ ☐ ☐ _____

PRINT OR TYPE

Aviation Support Equipment Technician
(ASE 3&2, ASM 3&2) Vol. 1, Basics
NAVEDTRA 10325

NAME ______________________________ ADDRESS ______________________________
Last First Middle Street/Ship/Unit/Division, etc.

____
City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ________________ DESIGNATOR ______ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ________________ DATE MAILED ________

SCORE

1 2 3 4
T F

1 ☐☐☐☐_____
2 ☐☐☐☐_____
3 ☐☐☐☐_____
4 ☐☐☐☐_____
5 ☐☐☐☐_____
6 ☐☐☐☐_____
7 ☐☐☐☐_____
8 ☐☐☐☐_____
9 ☐☐☐☐_____
10 ☐☐☐☐_____
11 ☐☐☐☐_____
12 ☐☐☐☐_____
13 ☐☐☐☐_____
14 ☐☐☐☐_____
15 ☐☐☐☐_____
16 ☐☐☐☐_____
17 ☐☐☐☐_____
18 ☐☐☐☐_____
19 ☐☐☐☐_____
20 ☐☐☐☐_____
21 ☐☐☐☐_____
22 ☐☐☐☐_____
23 ☐☐☐☐_____
24 ☐☐☐☐_____
25 ☐☐☐☐_____

1 2 3 4
T F

26 ☐☐☐☐_____
27 ☐☐☐☐_____
28 ☐☐☐☐_____
29 ☐☐☐☐_____
30 ☐☐☐☐_____
31 ☐☐☐☐_____
32 ☐☐☐☐_____
33 ☐☐☐☐_____
34 ☐☐☐☐_____
35 ☐☐☐☐_____
36 ☐☐☐☐_____
37 ☐☐☐☐_____
38 ☐☐☐☐_____
39 ☐☐☐☐_____
40 ☐☐☐☐_____
41 ☐☐☐☐_____
42 ☐☐☐☐_____
43 ☐☐☐☐_____
44 ☐☐☐☐_____
45 ☐☐☐☐_____
46 ☐☐☐☐_____
47 ☐☐☐☐_____
48 ☐☐☐☐_____
49 ☐☐☐☐_____
50 ☐☐☐☐_____

1 2 3 4
T F

51 ☐☐☐☐_____
52 ☐☐☐☐_____
53 ☐☐☐☐_____
54 ☐☐☐☐_____
55 ☐☐☐☐_____
56 ☐☐☐☐_____
57 ☐☐☐☐_____
58 ☐☐☐☐_____
59 ☐☐☐☐_____
60 ☐☐☐☐_____
61 ☐☐☐☐_____
62 ☐☐☐☐_____
63 ☐☐☐☐_____
64 ☐☐☐☐_____
65 ☐☐☐☐_____
66 ☐☐☐☐_____
67 ☐☐☐☐_____
68 ☐☐☐☐_____
69 ☐☐☐☐_____
70 ☐☐☐☐_____
71 ☐☐☐☐_____
72 ☐☐☐☐_____
73 ☐☐☐☐_____
74 ☐☐☐☐_____
75 ☐☐☐☐_____

PRINT OR TYPE

Aviation Support Equipment Technician
(ASE 3&2, ASM 3&2) Vol. 1, Basics
NAVEDTRA 10325

NAME ________________________________ Last First Middle
ADDRESS ________________________________ Street/Ship/Unit/Division, etc.
________________________________ City or FPO State Zip

RANK/RATE ________ SOC. SEC. NO. ________________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ________________ DATE MAILED ________

SCORE ☐

1 2 3 4
T F

1 ☐☐☐☐ - - - - -
2 ☐☐☐☐ - - - - -
3 ☐☐☐☐ - - - - -
4 ☐☐☐☐ - - - - -
5 ☐☐☐☐ - - - - -
6 ☐☐☐☐ - - - - -
7 ☐☐☐☐ - - - - -
8 ☐☐☐☐ - - - - -
9 ☐☐☐☐ - - - - -
10 ☐☐☐☐ - - - - -
11 ☐☐☐☐ - - - - -
12 ☐☐☐☐ - - - - -
13 ☐☐☐☐ - - - - -
14 ☐☐☐☐ - - - - -
15 ☐☐☐☐ - - - - -
16 ☐☐☐☐ - - - - -
17 ☐☐☐☐ - - - - -
18 ☐☐☐☐ - - - - -
19 ☐☐☐☐ - - - - -
20 ☐☐☐☐ - - - - -
21 ☐☐☐☐ - - - - -
22 ☐☐☐☐ - - - - -
23 ☐☐☐☐ - - - - -
24 ☐☐☐☐ - - - - -
25 ☐☐☐☐ - - - - -

1 2 3 4
T F

26 ☐☐☐☐ - - - - -
27 ☐☐☐☐ - - - - -
28 ☐☐☐☐ - - - - -
29 ☐☐☐☐ - - - - -
30 ☐☐☐☐ - - - - -
31 ☐☐☐☐ - - - - -
32 ☐☐☐☐ - - - - -
33 ☐☐☐☐ - - - - -
34 ☐☐☐☐ - - - - -
35 ☐☐☐☐ - - - - -
36 ☐☐☐☐ - - - - -
37 ☐☐☐☐ - - - - -
38 ☐☐☐☐ - - - - -
39 ☐☐☐☐ - - - - -
40 ☐☐☐☐ - - - - -
41 ☐☐☐☐ - - - - -
42 ☐☐☐☐ - - - - -
43 ☐☐☐☐ - - - - -
44 ☐☐☐☐ - - - - -
45 ☐☐☐☐ - - - - -
46 ☐☐☐☐ - - - - -
47 ☐☐☐☐ - - - - -
48 ☐☐☐☐ - - - - -
49 ☐☐☐☐ - - - - -
50 ☐☐☐☐ - - - - -

1 2 3 4
T F

51 ☐☐☐☐ - - - - -
52 ☐☐☐☐ - - - - -
53 ☐☐☐☐ - - - - -
54 ☐☐☐☐ - - - - -
55 ☐☐☐☐ - - - - -
56 ☐☐☐☐ - - - - -
57 ☐☐☐☐ - - - - -
58 ☐☐☐☐ - - - - -
59 ☐☐☐☐ - - - - -
60 ☐☐☐☐ - - - - -
61 ☐☐☐☐ - - - - -
62 ☐☐☐☐ - - - - -
63 ☐☐☐☐ - - - - -
64 ☐☐☐☐ - - - - -
65 ☐☐☐☐ - - - - -
66 ☐☐☐☐ - - - - -
67 ☐☐☐☐ - - - - -
68 ☐☐☐☐ - - - - -
69 ☐☐☐☐ - - - - -
70 ☐☐☐☐ - - - - -
71 ☐☐☐☐ - - - - -
72 ☐☐☐☐ - - - - -
73 ☐☐☐☐ - - - - -
74 ☐☐☐☐ - - - - -
75 ☐☐☐☐ - - - - -

PRINT OR TYPE

Aviation Support Equipment Technician
(ASE 3&2, ASM 3&2) Vol. 1, Basics
NAVEDTRA 10325

NAME ______________________ ADDRESS ______________________
Last First Middle Street/Ship/Unit/Division, etc.
____
City or FPO State Zip

RANK/RATE ______ SOC. SEC. NO. ______________ DESIGNATOR ______ ASSIGNMENT NO. ______

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ______________ DATE MAILED ______

SCORE

1 2 3 4
T F

1 ☐☐☐☐ _____
2 ☐☐☐☐ _____
3 ☐☐☐☐ _____
4 ☐☐☐☐ _____
5 ☐☐☐☐ _____
6 ☐☐☐☐ _____
7 ☐☐☐☐ _____
8 ☐☐☐☐ _____
9 ☐☐☐☐ _____
10 ☐☐☐☐ _____
11 ☐☐☐☐ _____
12 ☐☐☐☐ _____
13 ☐☐☐☐ _____
14 ☐☐☐☐ _____
15 ☐☐☐☐ _____
16 ☐☐☐☐ _____
17 ☐☐☐☐ _____
18 ☐☐☐☐ _____
19 ☐☐☐☐ _____
20 ☐☐☐☐ _____
21 ☐☐☐☐ _____
22 ☐☐☐☐ _____
23 ☐☐☐☐ _____
24 ☐☐☐☐ _____
25 ☐☐☐☐ _____

1 2 3 4
T F

26 ☐☐☐☐ _____
27 ☐☐☐☐ _____
28 ☐☐☐☐ _____
29 ☐☐☐☐ _____
30 ☐☐☐☐ _____
31 ☐☐☐☐ _____
32 ☐☐☐☐ _____
33 ☐☐☐☐ _____
34 ☐☐☐☐ _____
35 ☐☐☐☐ _____
36 ☐☐☐☐ _____
37 ☐☐☐☐ _____
38 ☐☐☐☐ _____
39 ☐☐☐☐ _____
40 ☐☐☐☐ _____
41 ☐☐☐☐ _____
42 ☐☐☐☐ _____
43 ☐☐☐☐ _____
44 ☐☐☐☐ _____
45 ☐☐☐☐ _____
46 ☐☐☐☐ _____
47 ☐☐☐☐ _____
48 ☐☐☐☐ _____
49 ☐☐☐☐ _____
50 ☐☐☐☐ _____

1 2 3 4
T F

51 ☐☐☐☐ _____
52 ☐☐☐☐ _____
53 ☐☐☐☐ _____
54 ☐☐☐☐ _____
55 ☐☐☐☐ _____
56 ☐☐☐☐ _____
57 ☐☐☐☐ _____
58 ☐☐☐☐ _____
59 ☐☐☐☐ _____
60 ☐☐☐☐ _____
61 ☐☐☐☐ _____
62 ☐☐☐☐ _____
63 ☐☐☐☐ _____
64 ☐☐☐☐ _____
65 ☐☐☐☐ _____
66 ☐☐☐☐ _____
67 ☐☐☐☐ _____
68 ☐☐☐☐ _____
69 ☐☐☐☐ _____
70 ☐☐☐☐ _____
71 ☐☐☐☐ _____
72 ☐☐☐☐ _____
73 ☐☐☐☐ _____
74 ☐☐☐☐ _____
75 ☐☐☐☐ _____